

ENVIRONMENTAL RESEARCH AND DEVELOPMENT

HEARING
BEFORE THE
SUBCOMMITTEE ON TOXIC SUBSTANCES AND
ENVIRONMENTAL OVERSIGHT
OF THE
COMMITTEE ON
ENVIRONMENT AND PUBLIC WORKS
UNITED STATES SENATE
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ENVIRONMENTAL RESEARCH AND DEVELOPMENT

TUESDAY, JUNE 14, 1983

U.S. SENATE,
COMMITTEE ON ENVIRONMENT AND PUBLIC WORKS,
SUBCOMMITTEE ON TOXIC SUBSTANCES AND
ENVIRONMENTAL OVERSIGHT,
Washington, D.C.

The subcommittee met at 11:10 a.m., in room SD-406, Dirksen Senate Office Building, Hon. Dave Durenberger (chairman of the subcommittee) presiding.

Present: Senators Durenberger, Mitchell, and Baucus.

Senator DURENBERGER. The hearing will come to order. I appreciate you all being here. I will forgo reading my opening statement, and will submit it for the record.

[The statement follows:]

OPENING STATEMENT OF HON. DAVE DURENBERGER, U.S. SENATOR FROM THE STATE
OF MINNESOTA

Good morning and welcome to the first of our hearings on the environmental research and development program of the Federal Government. The Subcommittee has scheduled one other hearing. That is on June 22nd in this same room.

There may be other Federal programs which have suffered funding cuts in the last two years like those in the environmental research and development, but there cannot be many. In constant dollars, the funding for research and development at the Environmental Protection Agency is at its lowest level since the mid-1970's. In other agencies which have historically maintained environmental R&D programs, the cuts have been as deep or deeper.

These reductions have forced us to focus on a fundamental premise underlying the years in which spending for environmental R&D at the Federal level continued to grow. That premise is whether there is a proper role for the Federal government in this field and, if so, what is its nature.

If there is a role for the Federal government—and I must confess at the outset that this Senator believes there is—another question is how and from where will we raise the money to finance Federal activities.

In many ways the funding reductions of the past two years present us with a unique opportunity. The Federal government has been supporting the environmental research and development programs two or more decades. The investments have produced information that led to the passage of the Clean Air and Water Acts, followed by other protective legislation ranging from the Toxic Substances Control Act to the Superfund law.

There can be no question that the environment is cleaner and Americans are healthier because we spent that money.

But just as we did many things right, we must have done some of them wrong.

We now have the opportunity to study the record of the past. Where discussions were wrong, they can be corrected; where they were right they can be reinforced.

I hope that before the Congress is over, we will have examined several areas. These include the following:

(1)

First, what should be the level of Federal support for environmental research and development and how should it be conducted. That is, what is the proper mix of university, private sector, and government-conducted research?

Second, how should this research and development program be financed. Specifically, should we institute a system to pass the costs back to the polluters in whole or in part or should we continue to pay from general revenues?

Third, what Agency or agencies within the Federal government should conduct or coordinate a research program?

And, finally, how can we assure that adequate resources are devoted to long-term research so that we can avoid the constant redirection of resources on a crisis basis?

Having spent the better part of the last four years working on issues of intergovernmental relations I can confidently predict that today's inquiries are unlikely to make headlines or the evening news.

But if they are not the stuff of which headlines are made, they are the stuff of which good government is.

So after my colleagues have had the opportunity to make opening statements, we will proceed without delay.

Senator DURENBERGER. I will ask our witnesses to come up. First, Dr. Albert H. Teich, science policy studies manager, American Association for the Advancement of Science. Albert, welcome.

Why don't we invite all of you to come up. Dr. Claren Davies, Dr. William Gledhill, Dr. James Mahoney, and Mr. Daniel Goodwin from Illinois.

We will proceed first with Dr. Teich. I thank you and I appreciate your patience with us.

The statements of all of the witnesses will be made part of the record. For some reasons that are by now obvious to you, we would appreciate your abbreviating your statements to the degree that that is possible.

STATEMENT OF ALBERT H. TEICH, SCIENCE POLICY STUDIES MANAGER, AMERICAN ASSOCIATION FOR THE ADVANCEMENT OF SCIENCE

Dr. TEICH. I have been cutting a page for every 10 minutes.

Senator DURENBERGER. Thank you.

Dr. TEICH. Mr. Chairman, I am grateful for the opportunity to present this testimony to you. As you invited, I am submitting my prepared statement for the record. I will make a brief summary of it at this point.

My purpose in this statement is to provide a context for your deliberations by looking at the overall situation of Federal research and development and the broad funding trends and prospects and to describe the place of environmental research, particularly EPA's research, in the overall picture of Federal R&D.

Let me introduce myself. I am manager of science policy studies at the American Association for the Advancement of Science, AAAS as it is known informally, which is a general scientific association with some 140,000 members. It publishes a journal *Science* and *Science* 1983, a popular monthly magazine on science.

One of my primary responsibilities at AAAS is running the R&D budget and policy project under which we prepare a series of reports each year. The latest of these is devoted to an analysis of R&D in the 1984 budget. A copy of it has been transmitted to your staff for its use in this investigation.

Our purpose in this project is to try and provide timely and objective analyses of R&D issues to both policymakers and the scientific and engineering communities.

Let me say a few words about overall Federal funding for R&D as a means of introducing this subject of environmental R&D. This is, as you know, a time of substantial change in the nature and scope of Federal Government activities, and R&D programs are being affected along with many others. Considering the overall budget climate, however, R&D has been treated, in the aggregate, reasonably well.

The administration has budgeted a total of nearly \$48 billion in budget authority for R&D in fiscal year 1984. That represents about a little more than 5 percent of the total Federal budget. That amount is more than the Federal Government has ever spent before for R&D, both in current and constant dollars, and it represents a substantial increase, more than 18 percent in fact, in current dollars over the fiscal 1983 level. That is in the aggregate.

If you look within that total R&D picture, you will find that there are two divergent trends at work, sharply divergent trends. What you see is that the 18-percent increase is the result of a 28-percent increase in defense R&D and no increase at all in the non-defense part of the Federal R&D budget. In fact, because it is essentially level, nondefense R&D will be losing ground to inflation during the current year under the proposed budget.

As a result of these divergent trends in defense and nondefense R&D, the overall character of Federal R&D is changing. In 1981, total Federal R&D was made up about half and half of defense and nondefense R&D. At the present time, the defense portion has grown to more than two-thirds, almost three-quarters of the total picture.

On the nondefense side, the administration has defined a science and technology policy which fosters basic research, particularly in the physical sciences. It has given special emphasis to basic research as an investment, a long-term investment, because of its future contribution to economic growth and national security.

At the same time, short-term research and applied research, which is more likely to be the province of the private sector, has been held level or reduced under the administration's policies. So the NSF budget, which is largely long-reach basic research, has been increased more than 17 percent in fiscal 1984 while, as we all know, the Department of Energy, for example, particularly the energy technology programs, which had aimed at producing short-term advances in energy technology, has been held back. For the third year in a row those programs have been substantially reduced.

Let me look now at environmental research in this context. It is kind of a mixed picture. Environmental research is sponsored by a variety of agencies in the Federal Government. Some of them have been increased during the past several years. Others have declined. Environmental research in NASA and NSF, for example, has grown during the past several years, while environmental programs in NOAA, in the Interior Department, in the Energy Department, and in the Agriculture Department have been cut back.

There is no single analysis under which the impacts of these shifts have been brought together to get a sense of what they all mean. OMB used to prepare an annual cross-cutting budget analysis of environmental R&D programs throughout the Government. It stopped doing that a couple of years ago. It would be a useful thing to be doing at this point.

Of course, the pivotal agency in environmental R&D is the Environmental Protection Agency, the direct subject of your interest here. As you know, the administration has scaled back EPA's overall staff and budget over the past 2½ years.

On the R&D side, the result of that scaling back has been an unprecedented reduction in the Agency's scientific activities—a reduction far deeper than that suffered by any other major R&D agency. Indeed, it is far deeper than that suffered by any Federal regulatory agency with a significant amount of R&D.

EPA's fiscal 1984 request of \$206 million for total R&D is down by nearly 50 percent in current dollars from its fiscal year 1983 level of \$385 million. The decrease, of course, is even greater when the effects of inflation are taken into account.

In my prepared text I have a couple of tables which show the breakdown of the EPA budget by program area and by media. I also show the recent budget history of the agency in comparison to a number of other Federal regulatory agencies or agencies which do research of regulatory importance. It is apparent that the cuts are widespread within EPA and that the reductions in EPA's research exceed those even of other Federal regulatory agencies.

Now, there is no universal law that says that large R&D budgets are good and small ones are not as good. But this is a rather drastic turnaround. It is worth spending a couple of minutes to assess its significance.

While these cuts have been going on in EPA's budget, there has in fact not been a corresponding decrease in EPA's responsibilities. In fact, EPA's responsibilities have, if anything, increased substantially over this period. Not only are the old problems still with us, but as several of my colleagues on the panel will say shortly, there are new problems being discovered all the time.

Some of the new problems which EPA is being asked to address are hazardous air pollutants and waste dumps, the need to improve the handling of toxic substances, indoor air pollution, and ground water contamination.

Many of the EPA budget cuts are justified in terms of the completion of specific projects and the reorientation of the Agency's R&D program from one that is broadly concerned with protecting the environment to one that is more narrowly conceived and centered on the immediate needs of regulatory programs which are mandated by law.

While it is clear that we do need budgetary austerity in this period of \$100 billion deficits, it is not at all clear that the kinds of reductions made in EPA's research programs are in the interests of either good science or good regulatory policy.

In fact, there are two points I would like to make with regard to those cutbacks before concluding this statement. One is the fact there are some real inconsistencies between the kind of R&D policies being applied to most other Federal agencies and those applied

to EPA. In most other agencies short-range R&D is being reduced and emphasis is being placed on long-range R&D which is viewed as an investment in the future and where the Federal role is most appropriate. At the same time, EPA's R&D efforts are being narrowed and increasingly restricted to short-term problems directly relevant, as I said, to the Agency's immediate regulatory needs.

The importance of R&D as an investment in future regulatory policy is being overlooked. EPA's ability to perceive future problems and develop responses as well as to make the best use of the opportunities presented by new technologies to deal with environmental problems is likely to suffer as a result of this narrowing of its focus.

Apart from the narrowing, there is also a problem of stability. Sound regulatory effort, as you know, requires good science on which public confidence can be built. Good science is dependent on a community of researchers, both inside and outside the Agency, interested in doing research in areas related to the Agency's mission. In order to encourage such a community of researchers, EPA has to demonstrate some stability in its long-term funding patterns. The abruptness of the cutbacks makes it difficult for the community to maintain its equilibrium. I think the results of these cutbacks are going to be felt in the years to come.

I think these are matters that deserve the attention of the scientific community and your attention, and I am pleased to have had the opportunity to bring them to your attention.

Mr. Chairman, that concludes my prepared statement. I look forward to responding to your questions.

Senator DURENBERGER. Thank you very much, Dr. Teich. That was an excellent overview.

Dr. Davies, executive vice president, Conservation Foundation.

STATEMENT OF DR. J. CLARENCE DAVIES, EXECUTIVE VICE PRESIDENT, THE CONSERVATION FOUNDATION

Dr. DAVIES. I also appreciate the opportunity to be here. I will try to make this very brief, given the scheduling problems.

Let me stress one major point, which is a point about the context in which to view R&D, and particularly R&D within EPA. The context is not from R&D policy, which is what Al Teich spoke about, so much as from environmental policy. But obviously the two are closely interrelated.

The kind of narrowing of focus that Al talked about, which has been the policy in EPA for the last 2½ years, probably doesn't make a whole lot of sense under any circumstances, but it certainly doesn't make any sense if you think that we don't know the right context for environmental policy or we don't know what the environmental problems are. If you think we know what all the problems are—and they are well-defined and well-accepted—then that can provide some kind of justification for the sort of narrowing that has taken place.

In fact, my own view is that we are just beginning a total reorientation of what we perceive to be the most important environmental problems and that concomitantly we are in very desperate need

of research to clarify the nature of those problems and to figure out what to do to solve them.

Let me just quickly run through some of the reasons why I think that.

Until the mid-1970's, we thought that we had to deal with only four or five major air pollutants and a handful of water pollutants. The recognition of the hazards posed by toxic substances has made us realize that we must cope with hundreds of pollutants, and we are still groping for feasible methods for determining the health effects of these pollutants, for monitoring their presence in the environment, and for technologies to control them.

Until the past few years, we thought that the geographical scope of the pollution problem was limited to a mile or two around a pollution source. We now realize that air pollutants may travel hundreds of miles, and we do not have the scientific information needed to cope with this realization.

Until recently we thought that the effects of pollutants were limited primarily to acutely toxic effects on humans and wildlife. We now realize that chronic health effects probably are more important than acute effects; and, even more jarring to our sense of the time dimension of environmental problems, that effects that may take decades or even centuries to be perceived, such as acid rain or global climate change, may have a major adverse impact on human health and welfare.

We are still suffering from the belief that pollution problems can be dealt with in neat compartments defined by the medium in which they occur, although we are gradually coming to realize that much of our present pollution control effort results only in shifting pollutants from one medium to another.

In short, all of the boundaries of time, space, number of pollutants, type of effect, and media that defined environmental problems 10 years ago are no longer valid.

I will, in the interest of brevity, not go into some of the implications or some of the priorities that I think this change of context means for R&D budgets, but clearly I think there are a number of implications, and certainly the one overriding implication is that one should not focus only on immediate, short-term regulatory needs because you are likely to be very off base if you do.

Thank you.

Senator MITCHELL [presiding]. Thank you, Dr. Davies. I apologize for the disconcerting nature of the hearing in which you address several different people in sequence. But Senator Durenberger will tell me what you said before I got here and I will tell him what you said after he left.

We have heard from two witnesses so far. Are you Dr. Gledhill?

Dr. GLEDHILL. Right.

Senator MITCHELL. Dr. Gledhill, go ahead. We are pleased to hear from you.

**STATEMENT OF DR. WILLIAM E. GLEDHILL, MANAGER OF
ENVIRONMENTAL SCIENCES, MONSANTO CO.**

Dr. GLEDHILL. Thank you.

I want to also thank the subcommittee for the opportunity to present my views on the need for environmental research. I will also try to shorten my statement.

I work for Monsanto Co. and am the manager of environmental sciences, which is a group responsible for assessing the environmental safety of our industrial chemical products. I am also a member of EPA's Pollution Control Processes Peer Review Panel, which is a group of scientists from academia, industry and EPA who review and recommend the funding of exploratory research programs outside the Agency.

As a scientist in industry who not only must establish the environmental safety of chemicals but also must deal with the numerous Federal, State and local regulations which affect the manufacture, use, and ultimate disposal of our products, I can only wholeheartedly support the development of the most appropriate scientific information on which to base regulation of chemicals in the environment.

Acquisition of scientific information requires research. We are currently carrying out a lot of our research in air, water and solid waste. However, from a practical standpoint, much of the regulations are simply requiring industry to achieve lower and lower levels without an apparent scientific rationale. We often don't know if such a technological approach to regulations actually protects human health and the environment. Industry often feels that we are just treating wastes for treatment's sake and not really doing something to protect the environment. Since the purpose of environmental regulations is to protect the environment, I feel we must have the scientific information to determine what is safe and what is not.

I think currently the main deterrent to these scientifically based regulations is the fact we do not have the necessary data on which to assess chemical safety under all environmental situations. We also don't have the consensus agreement among scientists on how to assess safety once we have the data. It is only through a continued, mutual interaction between all parties concerned that we will know that we are truly able to protect both the environment and human health.

As you are well aware, environmental research is going on in a large sector of Government, academia, private and public foundations and industry. But most of the research within EPA and industry has been conducted in a reactionary mode, as was mentioned by the first speaker. I think the short-term reactionary programs are of importance now, but it is really long-term anticipatory programs that will allow us to develop the information needed to really assess the environmental safety of chemicals.

I think also EPA has taken a lead role in sponsoring long-term environmental research. Previously the academic community found it difficult to find funding for relatively pragmatic environmental problems. EPA is to be credited with sponsoring the research in these areas. I think it is to EPA's credibility that it is directly linked to these scientific programs, and the quality of their staff and the programs are a positive signal to EPA that they are going in the right direction.

I think it is important that in order to maintain EPA research that they be able to continue to attract quality people who know how best to regulate chemicals from a scientific viewpoint.

I think thus far most of EPA's effort has been devoted to developing methodology geared at measuring chemical safety. But these methods and also EPA's scientific interaction with others outside the Agency is leading to a consensus on how to best assess chemical safety. Again, it is this cooperative mode between industry, academia, and the EPA labs that will be a benefit to all. I think it is certainly easier to achieve our environmental goals when all involved understand what needs to be done and how best to do it.

I also have a few comments about EPA's extramural research program. As I mentioned, I am a member of one of EPA's peer review panels. I think creation of such a panel attests to EPA's commitment to assure itself that it is funding the best research. I think there is a vast amount of talent in the academic community which can contribute to long-term ecological problems. Problems such as the orphaned waste sites, chemical spills, chemicals sorbed to sediments, process effluents and emissions, ground water contamination, and acid rain are all problems that are so broad in scope that no single laboratory could adequately develop all the information required to make sound scientific decisions. The academic community possesses an array of talent that can contribute.

But as I mentioned previously, it has been difficult for academia to find funding for some of these practical problems. EPA's Exploratory Research Grants program has afforded the necessary support to involve academia. Research programs geared to solving basic environmental problems often by new and fresh talent was initiated a few years ago. Some of these programs are now just nearing completion. We have seen advances in pollution control, engineering processes and biological assessments.

As I viewed the proposed fiscal year 1984 budget, I noticed significant cuts were proposed for EPA's long-term research. I believe the House Committee on Science and Technology feels that 20 percent of the research funds should be devoted to long-term research. This is up from 15 percent in 1982 and 1983. But the House Appropriations Committee has only recommended 8.5 percent of the budget—that is \$12 million—to go to the Exploratory Grants program. This amount would not even cover the programs that are already in progress and those already approved in 1982 and 1983, yet alone support any new research programs in fiscal year 1984.

So I urge the committee, the subcommittee to support EPA's Exploratory Research Grants program at a level recommended in EPA's long-range plans.

In summary, all I can do is indicate to this subcommittee my feelings on the importance of a well-rounded EPA research program designed to put the best science into regulation. It seems inappropriate to me to significantly cut financial support for these programs. If anything, more dollars should flow to environmental research.

Thank you.

Senator BAUCUS [presiding]. Thank you very much, Dr. Gledhill.

Our next witness is Dr. James Mahoney. Why don't you proceed to summarize your statement. As I understand the procedure, all

the witnesses at the conclusion of their summaries will be available to answer questions by whomever is here.

STATEMENT OF DR. JAMES R. MAHONEY, SENIOR VICE PRESIDENT, ENVIRONMENTAL RESEARCH AND TECHNOLOGY, INC.

Dr. MAHONEY. I understand, Mr. Chairman. I will make a brief summary of my statement.

My name is James R. Mahoney. I am cofounder and senior vice president of Environmental Research and Technology, Inc. I also serve as one of the three public members appointed by President Reagan to the Interagency Task Force on Acid Precipitation, which has oversight responsibility for the Federal acid precipitation research program.

I appreciate your invitation to appear here today before the subcommittee, and my comments are grouped into four categories. First, the need for federally sponsored environmental research and development; second, recommended goals for this research and development; third, and a key point, the need to improve collaboration between Federal and non-Federal support for research and development; fourth, a brief listing and discussion of certain high priority research and development needs.

First the need for federally sponsored environmental research and development.

Although substantial environmental research has been carried out in the United States since the late 1960's, the need for effective research is greater today than ever before for two reasons. First, we have come to learn that significant health and environmental effects can result from many of the persistent toxic substances which are associated with the advanced technology used in our industry, our agriculture and our transportation systems. Second, we cannot mitigate or control all possible environmental risks in the foreseeable future. Thus, we must rely on an aggressive research and development program to prioritize and to resolve the most challenging risks in our society. I do not believe that our current national research program is adequate for this task.

Second, some recommended goals for environmental research and development.

I believe that federally supported environmental research and development should have five principal goals. It should, first, explore for possible risks to public health and the environment; second, it should analyze cause-and-effect relationships—for example, our ability to prescribe cost-effective reductions in acid deposition is severely limited at this time because of our lack of technical understanding of the key factors and reaction rates which influence the source-transport-transformation-deposition chain for air contaminants; third, our research must monitor trends of contamination in the environment; fourth, it must prioritize among environmental risks, returning to my previous point that we cannot solve all problems in the short-term we must develop priorities; fifth, our research and development program should develop effective and cost-efficient control methods. Public sector funding of seed money to explore innovative control methods must be contin-

ued, especially for the management of toxic substances in air and wastewater streams.

The key point is the need for improved collaboration between Federal and non-Federal sponsored research and development.

Environmental research needs in the United States are so large and the constraints on the Federal budget are so severe that optimum coordination and efficiency must be sought between Federal and non-Federal supported activities. I make this point in particular because this degree of collaboration has not frequently been found in the past. I believe there is room for some real improvement in the collaboration between the public and private sectors and various Government sectors in this area.

I will briefly cite examples from three high priority research areas. First, acid precipitation research. Although the Federal budget commitment to acid precipitation research is relatively large, over \$25 million in the current fiscal year, other major multiement programs are underway and are being expanded by the Electric Power Research Institute and by provincial and national government units in Canada, among others. Acid precipitation does not respect political or sectorial boundaries, and EPA should seek the most complete collaboration possible with these other programs and should encourage other sponsors to develop complementary aspects of the needed research.

Another example is toxic substance studies. In all modern industrialized nations a very large group of potentially hazardous substances is found in the ambient environment. Research needs for effects assessment, description of the fate of these substances in the environment, and evaluation of control options are much greater than the research capacity of the Federal Government alone. Formal collaboration between EPA, industry-sponsored studies and university research is needed to share the burden of needed research.

The final example I list is ambient monitoring. Ambient monitoring is carried out throughout the Nation by a very large group of sponsors, including EPA, State environmental agencies, regional government units, regulated industries, and universities. Although many attempts at national recordkeeping, methods standardization, and quality assurance programs have been initiated, only a small percentage of all ambient measurement data is ever organized into useful regional and national scale data bases. Monitoring is intrinsically expensive, and EPA should do all possible to maximize the utility of the available measurement programs. This is an old issue, but our national performance in gathering useful monitoring data has not significantly improved in many years, in my view.

Finally, a brief comment on what I would consider high priority research and development needs.

I want to recommend five key R&D areas for special consideration by the committee. These include the three examples I previously cited and two others. In total, they are acid rain, toxic substances, ambient trend monitoring, personal exposure and dosage studies, including indoor air quality and food chain exposures, and finally new control technology developments.

Having already commented on acid rain, toxic substance needs and ambient monitoring needs, let me finish with a brief comment on the last two categories.

Personal exposure studies, incorporating, as I mentioned, indoor air pollution and food chain analyses.

Most human health effects related to pollutant exposure result from air exposures inside residential, commercial and industrial structures and from ingestion of food and water partly contaminated with pollutants. Increased research emphasis on actual personal exposures, health risks and mitigation measures should be considered by the subcommittee.

Finally, new control technology development.

In recent years Congress has decreased its authorizations for pollution control technology development because the private sector has developed commercial technologies in many cases, for some of the standard pollutants. However, new control needs continue to be identified; for example, for trace amounts of toxic substances in air emission and wastewater streams. Moreover, more research and development on system controls is needed in some important cases. For example, least-emissions dispatching from electric power networks may be a low-cost alternative to widespread application of flue gas desulfurization technology. Congress should continue to provide development support for those control options which would not normally be developed by private sector initiative.

I trust these comments will be useful in your considerations. I again appreciate the opportunity to share these views with you. Thank you.

Senator DURENBERGER [presiding]. Thank you very much, Dr. Mahoney. I hate to let you go.

We will go to Daniel Goodwin, manager, Division of Air Pollution Control, Illinois Environmental Protection Agency, representing State and Territorial Air Pollution Program Administrators.

STATEMENT OF DANIEL J. GOODWIN, MANAGER, DIVISION OF AIR POLLUTION CONTROL, ILLINOIS ENVIRONMENTAL PROTECTION AGENCY

Mr. GOODWIN. Thank you, Mr. Chairman.

On behalf of STAPPA, I want to thank the subcommittee for this opportunity to present the views of State regulators on the Nation's environmental research and development program.

There is probably no area of Government activity pertaining to environmental protection where State officials must depend more heavily on Federal assistance than the area of research. Improved knowledge of pollutant sources, transport, fate, monitoring techniques, effects on vegetation and materials, and especially effects on human health, are crucial to the success of State programs for air pollution control.

Yet no State could possibly provide itself with adequate research support using only its own resources. Not only would the cost be prohibitive, but the network of academic and scientific communication institutions which forms the infrastructure of a productive research program demands a national-scale effort. Consequently, I would urge the Congress to regard a vigorous Federal environmen-

tal research and development program as an essential component of the evolving Federal-State partnership for managing environmental quality.

Careful thought must also be given to the respective roles of the Federal Government and the private sector in the conduct of needed environmental research. Unlike computer science, pharmaceuticals, genetics, electronics, materials science, and many other fields of research and development, the potential for profit is largely ineffective as a driving force for privately funded environmental research. Most of what does occur in the private sector is defensive in orientation; that is, it is done for the purpose of disproving the existence of an environmental problem or the propriety of a contemplated regulatory requirement.

While this defensive research often produces valid, useful information for Government decisionmakers, we must rely on the public sector to seek out the subtle adverse effects on health and environment which result from man's activities and to develop the understanding of the physical, chemical, and biological processes that lead to those adverse effects so that they may be avoided or remedied.

Even where the need for corrective measures has been identified, it would be unwise to rely entirely on the private sector to provide solutions. The argument that the free enterprise system will assure development of improved pollution control technology by providing rewards to companies which develop most cost-effective control techniques is weak at best. Several overriding factors interfere with this mechanism for innovation.

First, it should be recognized that most companies that have strong research and development capabilities are simply not interested in whatever market may exist for pollution control technology. They have plenty of projects pertaining to the markets they do find of interest to utilize fully their available research and development resources.

Second, our national environmental regulatory scheme rarely provides incentives for innovation but it often provides disincentives. I have provided a couple of examples of that in my prepared text.

This point has not been offered as a criticism of our regulatory scheme but, rather, to illustrate the point that continued Federal funding of control technology research, development, and demonstration is essential if we expect continued rapid innovation in this area.

Let me now turn to some specific subject areas where additional federally sponsored research is needed.

The members of this subcommittee are well aware of the slow pace at which the U.S. Environmental Protection Agency has moved in regulating emissions to the atmosphere of substances known or suspected to be hazardous to human health. Yet the public is quite properly demanding that protection against toxic air emissions be provided even where many uncertainties exist concerning health effects and needed level of control.

Because rapid improvement in this aspect of the Federal regulatory program does not appear imminent, a growing number of State and local air pollution control agencies have initiated efforts

to control toxic air emissions. Most of these programs are seen as providing an interim measure of control on the most important sources of hazardous pollutants until the full degree of control contemplated by Federal law can be defined and implemented.

Assessment of the health effects of the much-discussed list of 37 substances should be a matter of highest priority in the Federal environmental research program. In addition, information on the sources, transport, fate, and control methods for these substances is needed not only by air quality regulators but by our counterparts in water quality and waste management as well. State and local environmental officials must make timely permit and standards decisions for sources of these substances virtually every working day, and the absence of complete information does not excuse us from those decisions. Consequently, those sources which do in fact pose significant health risks may escape adequate control by virtue of our ignorance. Accelerated research, and equally important improved information dissemination to State and local regulators, are crucial to prevention of blind decisionmaking for these sources of pollution.

Another high-priority research area is acid deposition. The increased emphasis on acid deposition research contained in the administration's fiscal year 1984 budget is commendable and should be endorsed by Congress irrespective of the outcome of the debate on whether immediate control measures are warranted. Clearly we need a vastly improved understanding of the acid deposition phenomenon.

A third area where a vigorous Federal research program is important is that of energy development. Synthetic fuel production processes still loom as eventual, if not imminent, components of our national energy supply system. Characterization of the emissions and other environmental effects of these processes should continue as a Federal research priority, along with necessary mitigative techniques.

Techniques for reducing sulfur dioxide and nitrogen oxide emissions from combustion of coal and other fossil fuels are important both for energy independence and as possible acid deposition controls. Demonstration of improved SO_2 and NO_x control technology suitable for retrofit use, such as the limestone injection multistage burner technology, is especially important.

Finally, I will conclude by suggesting that the Federal environmental research and development program could be improved in terms of the utility and timeliness of its results if more systematic mechanisms were employed for surveying the program's customers; that is, the staffs of the Federal, State, and local regulatory agencies who apply the knowledge generated on a daily basis. If more systematic mechanisms for identifying critical knowledge gaps and emerging problem areas were used, the body of information generated would likely be more useful and timely for the regulators.

I thank you, Mr. Chairman, for the opportunity to testify. I will be glad to respond to any questions.

Senator DURENBERGER. Thank you very much.

I believe that concludes our witnesses. I want to, on behalf of the subcommittee, thank all of you for the effort that went into preparing your testimony today. You have provided us with an excellent

background and foundation on which we can build our questioning of our next set of witnesses. To that extent you have made a tremendous contribution to the work of this subcommittee.

First let me ask all of you, in reading the statements and listening to the testimony, there seems to be some broad general agreement among the five of you on certain points. I would like to review those and get your reaction or elaboration on them.

It seems to me, first, you all shared the view that Federal involvement in environmental research and development is essential, and for a variety of reasons the Federal Government is uniquely situated to collect money, recognize national research needs, distribute that money in an efficient fashion, and, in effect, one coordinated research effort sure beats 50 from an efficiency of dollars expended and impact gained.

Second, you seem to share the view that the beneficiaries of the Federal research and development program include State and local governments, regulated industries, and, of course, the people who benefit from an environment which is cleaner and healthier.

Third, you also seem to be of the view that the cuts in the past 2½ years have been too deep or too much and too fast.

Finally, if we do not restore the budget to at least some degree and possibly make some reforms in the R&D program as well, that the ultimate consequence will be a drop in or deterioration in, environmental protection.

Let me just ask you if that is a fair summary and if anyone would disagree with any part of that or care to elaborate on what I believe to be a consensus of the testimony we heard here this morning.

Dr. TEICH. Yes.

Dr. MAHONEY. Mr. Chairman, I would like to make just one point, first in agreement with your summary. Then on the point of cuts, speaking as one individual, I certainly believe they have been too deep and too rapid, because a research program, by its nature, especially a mission research program of the sort the Federal Government principally through EPA but elsewhere as well has carried out, has a life and time scale which is much longer than a year or two. This is not an argument for stagnation and an argument for level funding over many years, but it almost follows axiomatically that if a program is cut to half its size in a year or two, there have to be many disefficiencies involved. It is a difficult balancing act to replace existing lines of research with important new topics when they come along. So it is always a judgment call, and there will always be some pain with changing a research program. But I would say the cuts of the order of one-half in a couple of years means inevitably important research which we have capitalized has not paid out because we dropped it too soon.

Senator DURENBERGER. Would somebody care to add to that?

Mr. GOODWIN. Yes. I would like to add my endorsement to that point and urge that stability of funding may be almost as important as the total amount on a year-to-year basis in determining the productivity of the research program.

Senator DURENBERGER. Maybe I can pick up on that point a little bit. One of the common criticisms of EPA research is that it is driven by too many regulatory demands. In fact, some of the re-

search is conducted in the context of either regulation or litigation, and it is very largely outcome oriented. It is funded with the hopes of deriving some information to support a regulation or to support a position in litigation.

A case in point is the chromosome study done at Love Canal. It is the committee's understanding of that project that it was undertaken to gather information in support of the lawsuit filed by the Federal Government against Hooker Chemical.

The concern here I think is that this approach might result in one faulty project having an effect of undermining the credibility of literally hundreds of properly designed and reviewed projects.

I want to get to a question suggested by the fact that I think in Dr. Teich's testimony you listed for us a wide variety of Federal agencies which are involved in environmental research. We all know that other people in the private sector are doing it also. You pointed out one interesting item to me that I didn't realize, and that is that we had tried to tie this together at one point with OMB doing a cross-cutting annual analysis of what is going on and where. The current OMB has abandoned that.

My question is, Would any of you recommend to us that the Congress consider creating a separate environmental research agency which would be, to some degree, independent from the Environmental Protection Agency, or is it possible that the kind of research which EPA conducts is subject to such intense scrutiny by both environmental groups and industries that all these flaws that I seem to be concerned about will inevitably be found and eliminated? Would anybody care to comment on that notion?

Dr. DAVIES. I think one has to distinguish among different kinds of research conducted by the Agency. My own view is that there is some amount of what is labeled exploratory research, and some other more basic research that goes on within EPA which is not intended to be responsive to the regulatory programs and in fact is not. The remainder of the research, or at least a large portion of it, certainly more than half I think, has in the past been criticized for being not responsive enough to the regulatory programs.

In fact, if you talk to the program people in EPA, most of them still will tell you that they have great trouble getting the Office of Research and Development to be responsive at all to them. So I think you have problems on both ends.

It seems to me that our experience with things like the division between the National Institute of Occupational Safety and Health on the one side and OSHA on the other indicates very clearly that to separate the research that is immediately necessary for regulation from the regulatory agency is a mistake. There is enough of a communication problem even if it is in the same agency, and the situation becomes impossible if you put them in different agencies. In fact, we have historical evidence on that in the environment in that the National Institute for Environmental Health Sciences for a while was envisioned as being the research arm for environmental regulation. That didn't work either.

Senator DURENBERGER. Would anyone else care to comment?

That sort of leaves me with the notion we ought to use our oversight function to pull this sort of thing together.

Dr. DAVIES. If I could just continue for 1 minute more, I think, however, that for some of the research that is less closely related to regulation that is done by EPA now, there one could in fact envision a separate agency. We in fact, as I mention in my testimony, are looking at the question of an ecological research center which could or could not be part of EPA but wouldn't necessarily have to be.

So there are things like some of the monitoring that is done, ecological research, some of the basic health effects research that I think could be separated.

Dr. TEICH. There is a sense of *deja vu* to some of these discussions because in the early days, around the time EPA was being established, there were discussions in the Senate and in the House of establishing that kind of an agency, a super agency for environmental research. There was talk of some of the transforming some of the large national laboratories into a set of national environmental laboratories. I believe Senator Jackson was involved in that proposed legislation. The idea was eventually dropped, and for the good reasons that Terry Davies points out, that you need the linkage with the users of the research. You also need a linkage between the long-term and short-term research.

I think EPA is capable of providing that linkage, although I think that the fact that the Agency has been a battleground for many conflicting views of the proper Federal regulatory role in the environment has hurt the research programs. The research programs have suffered as a consequence of differing views on environmental regulation.

To some extent what is needed is a consensus on the need to provide a bit of insulation for the research from the day-to-day vicissitudes of regulatory policy while at the same time assuring that the research programs provide relevant information.

If I could add a thought, there are many agencies in addition to EPA that do environmental research. It would be useful to think in terms of the integration of some of these research streams taking place in the field. What I mean is in the academic institutions and some of the nongovernmental research organizations.

EPA has fairly recently become active in supporting a set of environmental research centers at universities. One could envision that kind of presence sponsored by EPA tying in with environmental research thrusts funded by the National Science Foundation and other agencies in the universities, and a kind of knowledge base would be built up at that level, partly as a result of EPA's presence.

Senator DURENBERGER. Let me turn now to my colleague, Senator Baucus.

Senator BAUCUS. Thank you, Mr. Chairman.

One of the questions I have is what standards should we apply in deciding what the proper mix should be between public R&D, the environmental area, for example, and private R&D? What standards, what guidelines, what benchmarks? How do we know, in practical terms, for example, what the practical consequences and results would be if the line were drawn more in one direction than the other?

It is a question we have to face here. We have to have some standards. We have to have some guidelines generally. What do you suggest they be?

Dr. Mahoney. I think I would like to respond to that in a sense that might offer a further suggestion to Mr. Durenberger's question at the same time, too.

EPA has in place, and has had for a number of years, its Science Advisory Board, which sometimes has functioned quite well and other times, because of change and turmoil, has functioned less well. I think the beginning point for the development of standards about acceptable research comes through a peer review process and a process of independent evaluation by those who have a reputation to maintain in their scientific community.

I would argue that the Science Advisory Board, properly structured, gives the kind of blend of closeness to the Agency as well as an independent standing in the community. Indeed, I would suggest that especially your oversight subcommittee would do well to focus on the Science Advisory Board and indeed call upon it, specifically in hearings or through the mechanism of submitting a report back to the subcommittee, about its view of the status of research.

I would note that that would relate not only to the EPA program directly, for which it is responsible, but one of the questions which could be put to that Board is the proper mix of Federal sponsoring of especially EPA work and those projects which are run on the outside as well.

Mr. Goodwin pointed out in his testimony that industrially sponsored research tends to be defensive in nature, not surprisingly. At the same time, much of it tends to be very good. It is not worth doing if it isn't done well. Its budget is very large. Again, we ill-serve the Nation if we don't take full account of that where appropriate. The key to that is adequate scientific peer review.

Senator BAUCUS. I was asking for a little more precise help here. There is a gut feeling here that the R&D budget is too low, that it has to be increased. So we increase it. OK, it is cut 30 to 40 percent over the last year. It has to go up a certain percent. Not that it was cut in the last several years, but it has to go up somewhat. So the question is, how much should it go up. Should it be 25 percent, just to pick a figure out of the air. Can't we define that a little more? What do we look at? What guides, what considerations? That is as a practical matter. I am talking about practical effect, what is going to happen in terms of people getting sick and not getting sick, cleaner air, aesthetic consideration as well, trying to get away from the theoretical and to the practical here.

Dr. GLEDHILL. I will make one statement.

Senator BAUCUS. Obviously there is a very large role for private R&D.

Dr. GLEDHILL. There are major corporations that are doing basic research, and it is not all defensive. There is some geared at basically understanding what is going on. But I think that what is important is that we support research that allows us to make a decision. I mean just plain decisions like, for instance, the dioxin problem. There are so many arguments either way as to what does this

mean, the dioxin in the environment. But priorities like that have to be established by someone.

I think the SAB is a good example of where that can be done. We need to know what it means to have chemicals in different areas in the environment. We don't know what it means to have dioxin in the soil in levels that are being reported. We don't know what it means in terms of human health.

So there are lots of problems that need to be addressed and someone has to prioritize them.

Senator BAUCUS. What is going to be the greatest environmental problem facing America 10 years from today?

Dr. GLEDHILL. It is still going to be, in my opinion, the ability to assess the safety of chemicals in the environment, our developing the knowledge to say that in consumer use, these products are safe and these products are not safe, and the reasons why. We can't do that now in all cases.

Senator BAUCUS. Does everybody agree with that?

Dr. MAHONEY. A slightly different twist. Persistent toxic substances in the environment. How toxic is toxic in each case. How will we priority rank them. Which will we most aggressively control.

Senator BAUCUS. Which countries have the best programs in this area, that is the public R&D mixed with private R&D, in your judgment? Which countries do the best job here?

Dr. MAHONEY. I would argue Japan, largely because of a very strong collaboration and integration between public, private, and university research, coming out of an old cultural tradition in the program, very fine research program, very aggressive control program.

Dr. DAVIES. I would like to put a footnote on that, though. We at the Conservation Foundation deal a fair amount with both European countries and with the Latin American countries. There is no question that they look to the United States for their standard setting, for their research, for the total range of answers to environmental problems that come out of R&D. So the answer at least from their perspective is clearly the United States.

Senator BAUCUS. Why look to ours? Because they are better or more convenient?

Dr. DAVIES. I think in relation to Europe at least it is because it is better. We at least until recently——

Senator BAUCUS. By better do you mean higher?

Dr. DAVIES. No. More research having gone into the establishment of the standard.

Senator BAUCUS. We put more in than others; is that correct?

Dr. DAVIES. That is basically correct; yes. Yet what we put in is totally inadequate. In terms of principles as to how you make decisions in this area, my answer would really come down to two things: How important is it that we know the answer to that question; and if the Federal Government, or specifically EPA, doesn't do it, how likely is it that somebody else will, either the private sector or some other agency or whatever. So those are the two key questions.

In the case of things like research to back up standards, if we don't do it, it is not likely that any other country will.

Senator BAUCUS. Thank you all very much.

Senator DURENBERGER. I think the hour is getting late for you as well as for us. I have just one or two minor questions. Then I would like to submit a whole series of questions we have here.

Senator BAUCUS. I have a statement, too, I would like to include.

Senator DURENBERGER. Yes. It will be included.

[Senator Baucus' statement follows:]

OPENING STATEMENT OF HON. MAX BAUCUS, U.S. SENATOR FROM THE STATE OF MONTANA

Mr. Chairman, I join with you in welcoming our witnesses today to share their thoughts on the state of government sponsored research and development programs.

The news from EPA during the last three years has been bleak at best. EPA's research and development budget has been the fall-guy for the budget cutters.

The budget request for 1984 is down an intolerable 34 percent from 1981. This is not funding for abstract, "ivory tower" research. On the contrary, solid research is the only way we will learn to recognize and control the hundreds of toxic substances being pumped into our air, water, and land on a daily basis.

I have frequently expressed by opinion that the EPA research and development budget must be returned to a level sufficient to fulfill the Agency' mission of protecting public health. However, I will look forward to the views of the witnesses on this subject and I will follow up on the points they raise when the representatives of the Agency appear next week.

An equally important issue today is the role of the Federal Government in stimulating environmental research in the private sector. The Administration has placed heavy reliance on the industry's role solving environmental problems. I would appreciate hearing from the witnesses whether their approach is successful. If not, perhaps they can suggest incentives that would improve the process.

In addition, I hope that the experts appearing today will address the question of public confidence in environmental research—whether publicly or privately funded.

The rash of newly discovered dioxin incidents has called into question the credibility of the work performed to date. For example, EPA came under fire for circulating a draft report on dioxin contamination in Michigan to Dow Chemical. The resulting deletion of references to Dow as a possible source of contamination has heightened public fear of a cover-up.

The result is an overwhelming suspicion of many health-effects research projects. The public wonders if anyone is dealing honestly with them.

Any suggestions the witnesses may have on bolstering the research system to restore public trust would be most welcome.

Thank you.

Senator DURENBERGER. Max, I really appreciate your coming and changing your schedule to spend time here.

In my own personal involvement with some of the persistent toxic substance problems, my role as chairman of this subcommittee, Research and Development and a variety of other things, I somehow have gotten the impression, maybe erroneously, from certain university-based researchers that part of the problem here in the last 2½ years of cutbacks is not just the cutbacks but there has been, to a degree, a swinging away from university-based research in favor of national labs.

When I first heard that, I said, that sounds like David Stockman. It is a good way to keep the national labs going. You take a little bit away from this university and a little bit away from that one.

Is that a problem or is that just unique to a couple of universities that I may have spoken to?

Dr. TEICH. I could speak to that just briefly.

I call your attention to a study that you are probably familiar with that the Congressional Budget Office did concerning EPA's proposed 1984 budget, in which CBO cites some rather interesting sta-

tistics, showing how the cutbacks in EPA's R&D budget, have fallen more heavily on extramural programs than intramural programs. That is how an agency might behave when faced with a budget cut. It might tend to preserve its own core programs and staff and institutions, laboratories, if it can, in the hopes that those might still be around to support an expansion in future years. This tendency is not surprising. When an agency funds extramural research it does so in order to tap resources when it needs them and to drop them when it no longer needs them.

Senator DURENBERGER. If I may pose another question to you regarding the role of the national labs, but on the point of consistency and being around in the future when you need them, that is a large part of the university-based research, too. What we get at universities is a lot of other things as well. We are going to get education, we have community impact, we have regional impact, we have business accessibility, we have the direct involvement of a variety of local businesses. You find people—I keep thinking about the young man I met at the University of Minnesota recently who is Dutch, and I am exploring ground water problems, and obviously the Dutch have as much experience as anybody in the world with ground water problems. The best Dutchman is at the University of Minnesota right now because he wants to be there and he is able to make some contribution. But, there are a lot of people like him in university communities. It seems to me that their future in this same context of being around and impacting is threatened by the inconsistency in R&D budgeting. Is that a valid point that needs affirmation?

Dr. TEICH. I think you are quite right. I was not defending that particular form of administrative behavior, but only using it as an explanation of what had happened. In fact I agree with you, I think the consequences, can be quite negative.

In addition to the aspect you cite, you also lose the educational benefits in cutting back on university funding. I think there have been some statistics, although I can't bring them to mind instantly, which have shown reductions in the number of students taking degrees in environmental areas, for example. I think that does not bode well for our future capabilities to do environmental R&D.

Mr. GOODWIN. I don't speak with any particular preference in mind here, Senator, but what I would like to think of as a hard-headed program manager who has some experience with contract research with universities.

As a practical matter, that kind of research almost always carries a very high overhead factor with it. If I were running EPA's research program, one of the things I would be looking at as a way of assuring that I got the most mileage out of the available dollars would be to try to reduce the amount of nonproductive overhead I was paying for the program, whether it be my own overhead in my own in-house laboratories or extramural institutions. I think that might very well be an important factor in EPA's decision.

Dr. MAHONEY. If I could add one comment. I do have some at least historic bias, having spent a decade on the faculty of public health at Harvard. So I am somewhat familiar with the process of trying to compete for research grant support in the university context.

I do concur with the point of your comment that it is very important to keep the diversity and the geographic presence around the country which is represented by having an active university research program. It is certainly true in the balance that we need the national labs as well.

But there is one point of measure which may be useful. If we simply look at the amount of environmental research support going into the national labs and compare it with that going into the universities in total, I think we will find the national labs have fared fairly well in the recent years, largely because as a kind of in-house group to be protected they have reprogramed into doing this work. But we have to be very careful that we don't by such reprogramming cut off fertile new ideas which come from a range of different contexts as we get in the universities. I would find university overhead, by the way, to be small compared with private sector overhead. That is something I am very familiar with these days. There is no question you buy less control but more imagination and pluralism and important educational benefits with dollars spent at the university level.

Senator DURENBERGER. Thank you very much.

Max, anything further?

Senator BAUCUS. No, thank you.

Senator DURENBERGER. Let me thank all of you. As I indicated, we do have a batch of questions that we would like to submit to you to be responded to in writing. Thank you again.

The hearing is adjourned.

[Whereupon, at 12:15 p.m., the subcommittee was recessed, to reconvene subject to the call of the Chair.]

[Statements submitted for the record follow:]

Statement of
Dr. Albert H. Teich
Manager, Science Policy Studies
American Association for the Advancement of Science
Washington, D.C.

before the
Subcommittee on Toxic Substances and Environmental Oversight
Committee on Environment and Public Works
U.S. Senate

Hearings on Federal Environmental Research and Development Programs

Washington, D.C.

June 14, 1983

Mr. Chairman and Members of the Subcommittee:

I am grateful for the opportunity to present this testimony to you today. Environmental research is a vital element of the nation's R&D program, and an area of critical importance in the development of sound policies for environmental protection. I am pleased to see it receiving the attention of this Subcommittee.

What I intend to do is to provide a context for the Subcommittee's deliberations by reviewing the overall situation of federal R&D, the broad funding trends and prospects, and the place of environmental research -- particularly EPA's research -- within the federal R&D picture.

Let me first introduce myself. I am Manager of Science Policy Studies at the American Association for the Advancement of Science (AAAS), a 135-year-old general scientific association with some 140,000 members. I hold a bachelor's degree in physics and a Ph.D. in political science from MIT, and I have worked in science and technology policy for nearly 14 years. One of my current responsibilities is running the AAAS R&D Budget and Policy Project.

This project, which is in its eighth year, is an attempt to provide authoritative, timely and objective information on budget and policy issues relating to research and development to the scientific community and concerned policymakers. A copy of our most recent report, AAAS

Report VIII: Research and Development, FY 1984, has been provided to the Subcommittee staff for use in the Subcommittee's examination of environmental research. My colleagues and I stand ready to provide additional assistance to the Subcommittee, should you require it.

Overview of R&D Statistics

R&D in the United States is a vast enterprise. The National Science Foundation estimates that, during 1983, the nation will spend \$86.5 billion on R&D. Of this amount, slightly more than half will come from private sector funds, and slightly less than half from federal funds. The unique strength of the U.S. R&D system derives in part from the ties between the sectors involved. About three-fourths of the R&D supported with federal funds is actually performed by scientists and engineers working outside of government -- in industry, universities, and nonprofit institutions.

The private sector component of R&D is large and growing -- growing faster, in fact, than the federal component. To a large extent it is comprised of applied research and development supported and conducted by individual firms for their own purposes, mainly to create new products and processes. Industrial R&D is heavily concentrated among a few industries (e.g., the automotive, chemical, pharmaceutical, electronics, and aerospace industries) and among the largest firms in those industries. Only a few of the largest firms support significant amounts

of basic research.

The focus here, however, is on the federally-funded component of R&D. The federal government supports R&D to meet its own needs -- in national defense or environmental regulation, for example -- and to serve national needs, where private sector mechanisms are not adequate to the task -- as in health, agriculture, and basic research.

This is a time of substantial change in the nature and scope of federal activities and the federal government's R&D efforts are being affected along with many other programs. Considering the overall climate of austerity, however, R&D has generally been treated well in the budget process -- at least at the aggregate level. The total amount budgeted by the administration for R&D in FY 1984 is \$47.8 billion in budget authority. At this level, R&D represents a little more than 5 percent of the total federal budget.

The FY 1984 total for R&D is more than the federal government has ever spent for R&D before in current or constant dollars. It represents a marked increase over the total for FY 1983 -- more than 18 percent in current dollars.

Federal R&D is supported by many different agencies and departments and serves many different purposes. These agencies and purposes do not, by any means, share equally in the projected budgetary growth. In fact,

if you divide the total R&D effort into two major components -- defense and non-defense (everything else) -- you can see two sharply divergent budget trends. Defense R&D is budgeted for a very large increase over FY 1983 -- nearly 28 percent. This is an even larger percentage increase than that of defense spending generally. Nondefense R&D is budgeted for no increase at all. It is essentially level with FY 1983, which means that it will lose ground to inflation. This is roughly in keeping with the treatment of all nondefense discretionary programs.

As a result of these divergent trends in support of defense and nondefense R&D, the overall character of federal R&D is changing. In FY 1981, just prior to the administration's current defense build-up, defense constituted 51 percent and nondefense 49 percent of total federal R&D, which was then \$37.3 billion. In FY 1984, total federal R&D has grown to \$47.8 billion. Within this enlarged total, defense now represents 69 percent, nondefense 31 percent. Indications are that Congressional action will shift this balance somewhat by increasing nondefense R&D and reducing defense R&D, but the change is not likely to be more than 1 or 2 percent.

The lion's share of the increase in the defense R&D budget is in the "D" portion of R&D, engineering development, testing and evaluation of large-scale hardware programs, mainly strategic weapons systems. Basic science sponsored by the Pentagon and applied research increase also, but not nearly to the same extent.

Nondefense R&D in the Federal Government

Nondefense R&D is supported by more than 25 federal agencies and departments. Their programs range from \$3 to \$4 billion-plus in the cases of DOE, HHS, and NASA to a few tens of millions of dollars in the cases of Labor, HUD, and Treasury. Some of these agency R&D efforts have fared reasonably well during this period of budget austerity, others have been cut back sharply.

The administration has defined a science and technology policy under which funding for basic research, particularly in the physical sciences, mathematics, and engineering, has been given special emphasis, as investment in its future contribution to economic growth and national security. Other areas of basic research (social sciences and life sciences, for example), as well as applied research and development, especially in areas of commercial potential, which the administration feels ought to be the province of the private sector, have been held level or reduced. Thus, for example, NSF's R&D budget has been increased more than 17 percent in FY 1984, while DOE's budget (particularly for applied research and development in non-nuclear energy technologies) has been reduced, the third successive year of such reductions.

Applied research and development programs in many civilian agencies have been reduced not as part of any coordinated, government-wide effort

to reshape federal R&D, but as a result of broad budget cutbacks and internal agency competition for funds under several overall budget constraints. The effect on the national R&D effort has been uneven.

Federal Environmental Research

This unevenness is apparent in the area of environmental research. Apart from EPA, whose situation will be discussed in the next section, environmental research is supported by a variety of federal agencies including the Departments of Interior, Commerce, Energy, Health and Human Services, and Agriculture, as well as NASA and NSF. While environmental research in NASA and NSF has grown during the past several years, programs in Commerce (NOAA), Interior (Fish and Wildlife Service, Bureau of Reclamation), Energy, and Agriculture (Forest Service) have been cut back. The impacts of these shifts are not clear, although they merit the attention of those concerned with the state of the environment. It would be helpful for a central decision-making body to monitor the changes in relation to one another. For a number of years OMB prepared an annual government-wide cross-cut budget analysis of environmental R&D programs. It stopped doing so about two years ago.

R&D in the Environmental Protection Agency

The pivotal agency in environmental R&D is, of course, EPA.

As you know, the administration has sharply scaled back EPA's overall budget and staff over the past two and a half years. On the R&D side, the result has been an unprecedented reduction in the agency's scientific activities -- a reduction far deeper than that suffered by any other major R&D agency, indeed far deeper than any federal regulatory agency with a significant level of R&D. EPA's FY 1984 request of \$206 million for total R&D is down by nearly 50 percent in current dollars from the agency's FY 1981 level of \$385 million. The decrease is, of course, even greater when the effects of inflation are taken into account. Tables 1 and 2 present breakdowns of EPA's R&D budget by media and program and show FY 1983-84 percentage changes. As can be seen, only a very few elements of EPA's R&D program have escaped the budget ax. Table 3 compares the recent budget history of R&D in EPA with R&D funding patterns in three other federal regulatory agencies: FDA, NRC and NIOSH (which conducts R&D for OSHA). The degree to which the reductions in EPA's R&D exceed those of the other regulatory agencies is apparent in this third table.

Now, there is no universal law which says that large R&D budgets are always good and smaller ones are not as good. Nevertheless, this is a rather drastic turn-around for an agency which had been growing prior to FY 1982, and it is worth spending a few minutes assessing its significance.

The mission of EPA is to develop regulations to protect environ-

mental health and quality. Both the development and enforcement of environmental regulations require a sound scientific basis. Therefore, the primary focus of R&D at EPA is to provide the regulatory program offices with the needed scientific information. In support of this mission, R&D at EPA also has a role to play in ensuring that there exists a community of environmental scientists, outside the agency, that can be called on to provide advice and review.

EPA's R&D activities, may be grouped into two broad categories:

- (1) regulatory research of both a short-term (1-2 year) and longer-term (3-5 year) nature; and
- (2) exploratory research aimed at developing basic knowledge and principles for use in understanding present problems and anticipating future environmental problems.

EPA carries out its research through both in-house and extramural mechanisms.

As I noted a moment ago, since FY 1981, EPA has experienced a decrease in R&D funding of nearly 50 percent, from \$385 to \$206 million. Over this same time period there has not been a corresponding decrease in EPA's responsibilities. In fact, EPA's responsibilities have, if anything, increased substantially over this time frame. Not only are the

old problems still with us, but new problems are being discovered. Examples of new problems (or at least newly-perceived problems) which EPA is being asked to address include hazardous air pollutants and waste dumps, the need to improve the handling of new toxic substances (which are at present inadequately handled under TOSCA), indoor air pollution, and ground water contamination.

Many of the budget reductions are justified in terms of (1) the completion of specific projects, and (2) the reorientation of the agency's R&D program from one broadly concerned with protecting the environment to one much more narrowly conceived and centered on the immediate needs of regulatory programs that are mandated by statute. While the need for budgetary austerity in a period of \$100 billion plus deficits is inescapable, it is not at all clear that the kinds of reductions that have been made in EPA's R&D programs are in the interests of either good science or good regulatory policy.

There is, in fact, some inconsistency between the R&D policies being applied to most other federal agencies and those being applied to EPA. In many other agencies, short-range R&D is being reduced and emphasis is being placed on long-range R&D, which is viewed as an investment in the future and an area in which the federal role is most appropriate. At the same time, EPA's R&D efforts are being narrowed, increasingly restricted to short-range problems directly relevant to the agency's immediate regulatory needs. The importance of R&D as an investment in future

regulatory policy is being overlooked. EPA's ability to perceive future problems and develop responses as well as to make the best use of opportunities presented by technological advances to deal with environmental problems is likely to suffer as a result of this narrowing of its R&D focus.

Apart from the narrowing, there is the problem of stability. A sound regulatory effort requires good science on which public confidence can be built. Good science is dependent on a community of researchers both inside and outside the agency interested in and doing research in areas related to EPA's mission. In order to encourage such a community of scientists, EPA must demonstrate long-term funding patterns reflecting, if not growth, at least stability. The abruptness of the budget cutbacks in EPA is making it difficult for this community of researchers to maintain its equilibrium. In view of the time lag between the completion of a research project and the utilization of its findings in the regulatory process, the results of these dislocations are likely to be felt in coming years. These are matters which deserve serious attention both among environmental policymakers and in the scientific community.

Table 1 R&D in the Environmental Protection Agency
(budget authority in millions) by Media.

Media	FY 1982 Actual	FY 1983 Est.	FY 1984 Budget	% Change FY 1983-84
"R&D" appropriation and R&D portion of "Salaries and Expenses" approp.				
Air	\$ 63.2	\$ 59.4	\$ 51.2	-13.8%
Water Quality	53.5	30.6	19.3	-36.9%
Drinking Water	30.9	23.3	20.9	-10.3%
Hazardous Waste	29.2	33.0	27.4	-17.0%
Pesticides	7.1	6.5	6.1	-6.2%
Radiation	2.6	1.7	0.2	-88.2%
Interdisciplinary	6.7	7.0	18.1	+158.6%
Toxic Substances	34.1	27.2	23.8	-12.5%
Energy	62.3	25.0	23.5	-6.0%
Superfund	13.8	6.3	6.4	+1.6%
Program Management and Support	7.9	8.7	8.7	—
Adj. for rounding	-0.2	0.3	0.5	
TOTAL	\$311.1	\$228.6	\$205.5	-10.1%

Table 2 R&D in the Environmental Protection Agency
(budget authority in millions) by Program.

Program	FY 1982 Actual	FY 1983 Est.	FY 1984 Budget	% Change FY 1983-84
Health Effects	\$ 59.8	\$ 45.6	\$ 41.2	-9.6%
Environmental Processes & Effects	68.7	49.4	44.1	-10.7%
Monitoring Systems & Quality Assurance	39.9	35.5	32.5	-8.5%
Acid Rain	9.2	12.5	14.0	+12.0%
Scientific Assessment	6.0	7.4	9.4	+27.0%
National Center for Toxicological Research	1.3	0.9	0.0	-100.0%
Technical Information & Liaison	2.4	2.6	2.6	--
Great Lakes Study	2.4	2.5	0.0	-100.0%
Stratospheric Modification	0.9	0.9	0.9	--
Environmental Engi- neering & Tech- nology	106.1	58.3	36.5	-37.4%
Exploratory Research Core Program	6.6	4.4	15.5	+252.3%
Management & Support	7.9	8.7	8.7	--
Adj. for rounding	-0.1	-0.1	0.1	
TOTAL	\$311.1	\$228.6	\$205.5	-10.1%

Table 3
Conduct of R&D in Selected Regulatory Agencies,
FY 1981 - 1984 (budget authority in millions).

	FY 1981	FY 1982	FY 1983	FY 1984	% change FY 81-84
Environmental Protection Agency	\$ 375	\$ 285	\$ 234	\$ 207	-44.8%
Nuclear Regulatory Commission	227	221	210	200	-11.9%
Food & Drug Administration	71	73	77	82	+15.5%
National Institute of Occupational Safety & Health (CDC)	54	52	50	52	-3.7%

Source: Agency budget justifications.

Biographical Information

Albert H. Teich

Albert H. Teich is manager of science policy studies in the Office of Public Sector Programs at the American Association for the Advancement of Science. His principal responsibilities are in the R&D Budget and Policy Project. In addition, he is AAAS staff officer for the Committee on Science, Engineering and Public Policy. In 1980-1981, he directed a major AAAS project in support of the National Science Foundation's preparation of the second Five-Year Outlook for Science and Technology. Prior to joining AAAS, Dr. Teich was associate professor of public affairs and deputy director of the Graduate Program in Science, Technology, and Public Policy at George Washington University. Between 1969 and 1976, he served in a number of research, administrative, and teaching positions at Syracuse University Research Corporation and the State University of New York, including director of research of SUNY's Institute for Public Policy Alternatives in Albany. He has been a consultant to many organizations and federal agencies, including the National Science Foundation, and the House Committee on Science and Technology. Dr. Teich is the author of many articles and the editor of three books, Scientists and Public Affairs (MIT Press, 1974), Technology and Man's Future, 3rd ed. (St. Martin's Press, 1981), and Science, Technology and the Issues of the Eighties: Policy Outlook (Westview Press, 1982). He holds degrees in physics and political science from M.I.T.

TESTIMONY OF
DR. J. CLARENCE DAVIES
EXECUTIVE VICE PRESIDENT
THE CONSERVATION FOUNDATION
BEFORE THE
SUBCOMMITTEE ON TOXIC SUBSTANCES
AND ENVIRONMENTAL OVERSIGHT
COMMITTEE ON ENVIRONMENT AND PUBLIC WORKS
UNITED STATES SENATE

JUNE 14, 1983

My name is J. Clarence Davies. I am Executive Vice President of The Conservation Foundation, an environmental research and communications organization located in Washington, D.C. The Foundation has been conducting research on environmental policy questions for the past 35 years. I personally have been actively involved in environmental policy for the past 18 years, served six years as a member of the Executive Committee of the EPA Science Advisory Board, and was the first chairman of the EPA Administrator's Toxic Substances Advisory Committee.

There is a widespread view, reflected in the administration's proposed research budgets, that we know all the environmental problems that exist and that the only need is to deal with a well recognized and well defined set of environmental threats. My own view is that we are in the early stages of a

total reorientation of what we perceive to be the most important environmental problems, and that we are in desperate need of more research to help define the environmental problems of the future.

- o Until the mid 1970's we thought that we had to deal with only 4 or 5 major air pollutants and a handful of water pollutants. The recognition of the hazards posed by toxic substances has made us realize that we must cope with hundreds of pollutants, and we are still groping for feasible methods for determining the health effects of these pollutants, for monitoring their presence in the environment, and for technologies to control them.
- o Until the past few years we thought that the geographical scope of the pollution problem was limited to a mile or two around a pollution source. We now realize that air pollutants may travel hundreds of miles, and we do not have the scientific information needed to cope with this realization.
- o Until recently we thought that the effects of pollutants were limited primarily to acutely toxic effects on humans and wildlife. We now realize that chronic health effects probably are more important than acute effects and, even more jarring to our sense of the time dimension of environmental problems, that effects that may take decades or even centuries to be perceived, such as acid rain or global climate change, may have a major adverse impact on human health and welfare.

- o We are still suffering from the belief that pollution problems can be dealt with in neat compartments defined by the medium in which they occur, although we are gradually coming to realize that much of our pollution control effort results only in shifting pollutants from one medium to another.

In short, all of the boundaries of time, space, number of pollutants, type of effect, and media that defined environmental problems ten years ago are no longer valid.

The traditional boundaries are no longer valid, but we are just beginning the process of establishing new ones. What kind of research is necessary to deal with the new context of environmental problems? Let me just mention a few of the most important areas.

Health effects. More than 60,000 chemicals are used in commerce in the United States. Each year more than 1,000 new chemicals come on the market. Of these thousands of chemicals, we probably have good information about the health effects of only a few hundred. Testing of both new and existing chemicals needs to be accelerated.

However, existing testing methods will never allow us to obtain even a small fraction of the health effects information that we need. There are not enough skilled personnel or laboratory facilities, and not enough time or money to do the job. Research on improved testing techniques and studies aimed at a better understanding of the biological mechanisms involved in pollution-related health damage should have high priority.

Ecological research. The realization that pollution problems can no longer be dealt with only in neat compartments such as air, water, and land, means that we must gain a much better understanding of how the compartments interact, how pollutants travel from one medium to another, and how man's activities impact the natural systems that sustain life. Much of this understanding will come from ecological research.

It is not known how much ecological research the federal government does. The research that is done is scattered among a large number of agencies. No agency has central responsibility for coordinating this research or for obtaining the knowledge that may prove crucial to our existence. The Conservation Foundation is now investigating the feasibility and desirability of creating a National Ecological Research Center as a way of meeting these needs.

Pollution control technologies. Although we have the technology to control most of the common forms of pollution, the last few years have highlighted one major gap--our ability to deal with hazardous wastes. Disposal in landfills is no longer acceptable, but for many types of wastes there are no good alternatives. The goal, which is a realizable one, should be to eliminate hazardous wastes altogether. The genius of the chemical industry, which created the chemicals of which the waste is composed, should be able to develop the techniques to convert the hazardous substances either into reusable materials or into harmless substances. It is instructive that within a few years of PCBs becoming the focus of regulatory control efforts, the

private sector developed several new techniques for converting PCBs into harmless chemicals. These techniques were economical and practical, and even included one method that could be mounted on a truck and thus used wherever PCB disposal was required.

Social science research. Finally, let me say a word about social science research. We are spending billions of dollars each year to deal with environmental problems. But we are spending almost nothing to employ economists, political scientists, systems analysts, and other social scientists to evaluate the existing programs, to determine what factors lead to successful programs and what factors lead to failure, or to develop more efficient and effective approaches to dealing with environmental problems. A small amount of money invested in this kind of research could have a large pay-off.

In conclusion, let me quote from a Conservation Foundation report commenting on the 1982 and 1983 budget cuts: "Because of the budget cuts, the information base for environmental policy, always weak, is likely to be even weaker in the future. We will be less able to sort out important problems from unimportant ones, less able to tell which environmental programs are working effectively and which are not. Perhaps most important, the perennial dilemma of whether available information is sufficient to justify action will become more pervasive and difficult.

"Not to take action is itself a decision. To decide to wait for more information is, in fact, a decision not to take action. But the less adequate the available information, the more the decision to take or not take action will be based, even

more than in the past, on ideology or the instincts or self-interest of decision makers." In recent months we have seen some of the tragic consequences of this type of decision making.

TESTIMONY BEFORE THE TOXIC SUBSTANCES
AND ENVIRONMENTAL OVERSIGHT COMMITTEE

William E. Gledhill, Ph.D.

June 14, 1983

I want to thank the Subcommittee for this opportunity to present my views on the need for environmental research. I work for Monsanto Company and am the Manager of Environmental Sciences, a group responsible for assessing the environmental safety of industrial chemical products. I am also a member of EPA's Pollution Control Processes Peer Review Panel, a group of scientists from academia, industry and EPA who review and recommend the funding of exploratory research programs outside of the Agency. I'm here to present my views on both the need for and benefits of EPA supported environmental research.

As a scientist in industry who not only must establish the environmental safety of chemicals, but also must deal with the numerous federal, state, and local regulations which effect the manufacture, use, and ultimate disposal of our products, I can only wholeheartedly support the development of the most appropriate scientific information on which to base regulation of chemicals in the environment. Acquisition of scientific data requires research. I see a significant amount of our air, water and solid waste regulations simply requiring industry to achieve lower and lower levels of discharge without apparent scientific rationale. We often do not know if such a technological approach to regulations actually protects human health and the environment. I feel that sometimes we are just treating wastes, etc., for treatment's sake, not because we are doing so to protect the environment. Since the primary purpose of environmental regulations is to protect the quality of the environment and human health, we must have the information to know what is safe and

what is not. It is often not cost effective nor practical, to go to zero discharge.

Currently, we do not have the scientific capability to establish safety of chemicals under all possible environmental situations. This is the main deterrent to scientifically based regulations. We also do not have consensus agreement among scientists on how to assess safety once we have the data. It will only be through continued support of environmental research and mutual cooperation that we truly know that both the environment and human health are being protected.

Environmental research, as you are aware, is currently being carried out by a wide sector of government, academia, private and public foundations and industry. With all of the legal requirements and rush for implementing federal environmental regulations, most of the research within EPA and industry has been conducted in the reactionary mode, i.e., geared at solving immediate or crisis problems. Short term (reactionary) programs focused on immediate problems are important right now, but it is only through long term (anticipatory) programs that we will be able to develop the science which will allow us to make the best and most cost effective decisions on regulation and control of chemicals. Basically, the public demands a risk free environment from chemicals and it is only through research that scientists can put these risks into perspective. Larger companies such as Monsanto can contribute significantly to the development of the science; and they are doing so. Smaller companies, However, usually do not have the funding for such research and their efforts are directed primarily at compliance. The academic community has found it difficult in the past to find support for pragmatic environmental problems. EPA has taken a lead role in sponsoring environmental research both in its own labs and externally. Continuation of EPA programs is essential

since the Agency's credibility is directly linked to the quality of its scientific programs and staff. Clearly, to attract quality people who understand how best to regulate chemicals from a scientific viewpoint, a quality research program must be maintained. Furthermore, I feel a balance between internally sponsored and extramural programs is necessary. EPA is to be credited with the contributions of their research laboratories to date. Recently, the Duluth's labs' efforts to gather scientific (biological) data for use in the NPDES Permit System is an example of an EPA long range research program which will provide scientific basis for regulation of effluents in the future. Thus far, most of EPA's effort has been devoted to developing methodology measuring chemical safety, but these methods and EPA's scientific interaction with others outside the Agency is leading to a consensus viewpoint on how to assess chemical safety. Clearly the cooperative mode between EPA labs, industry and academia is a benefit to all. It is certainly easier to achieve our environmental goals when all involved understand what needs to be done and how best to do it.

What about EPA's extramural research? I mentioned I am a member of an EPA's Peer Review Panel. The creation of such panels attests to EPA's commitment to assure itself that they are supporting the best research. A vast amount of talent exists in the academic community which can contribute to long term ecological problems. Problems such as a) orphaned waste sites; b) chemical spills; c) chemicals sorbed to sediments; d) process effluents and emissions; e) groundwater contamination; and f) acid rain are all so broad in scope that no single laboratory could adequately develop all the information required to make sound scientific decisions. The academic community possesses an array of talent that can significantly contribute. However, up until recently, funding for such practical problems was hard to come by and

generally unavailable from conventional sources (NSF, NIH, etc.). EPA's Exploratory Research Grants Program has afforded the necessary support to involve academia. Research programs geared to solving basic environmental problems often by new or fresh talent, was initiated a few years ago. Some of these programs are just now nearing completion, and advances in pollution control (air, water), engineering processes, and biological assessments are emerging. I feel it is essential that these programs continue. As I viewed the proposed FY 1984 budget, I noticed a significant discrepancy between what EPA's long range research grants program requires and what is being recommended by the Committee reviewing this budget. The House Committee on Science and Technology feels that 20% of research funds should be devoted to long term research; this is up from 15% in 1982-1983. Yet the House Appropriations Committee, is only recommended 8.5% of the budget (\$12M) go to the Exploratory Grants Program. This amount wouldn't even cover programs in progress and those programs approved in 1982 and 1983 (\$15.6M), yet alone support any new programs. I urge you to support EPA's Exploratory Research grants program at the level recommended in EPA's Long Range Plans.

In summary, all I can do is indicate to this Committee my feelings on the importance of a well rounded EPA research program designed to put the best science into regulation. It seems totally inappropriate to me to significantly cut financial support for these programs. If anything, more dollars should flow to environmental research.

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Testimony of

James R. Mahoney, Ph.D.

before the

Subcommittee on Toxic Substances
and Environmental Oversight

of the

Committee on Environment and Public Works
United States Senate
Washington, D.C.

June 14, 1983

Mr. Chairman and Members of the Committee:

My name is James R. Mahoney. I am co-founder and Senior Vice President of Environmental Research & Technology, Inc., which has its headquarters in Concord, Massachusetts. I also serve as one of the three public members appointed by President Reagan to serve on the Interagency Task Force on Acid Precipitation, with oversight responsibility for the federal acid precipitation research program. During the past eighteen years I have frequently served as a technical and policy advisor to the Environmental Protection Agency and other federal agencies, as well as several international organizations and foreign government environmental agencies. I have also directed a large number of technical environmental studies sponsored by the private sector in the United States. My comments today reflect my professional judgement, based on the experience cited here.

I appreciate your invitation to provide the Subcommittee with comments about the need for federal environmental research and development efforts to serve the public interest. My comments today are grouped into four categories:

1. The need for federally sponsored environmental R&D.
2. Recommended goals for federally sponsored environmental R&D.
3. The need to improve collaboration between federal and non-federal environmental R&D programs.
4. A brief discussion of high priority R&D needs.

THE NEED FOR FEDERALLY SPONSORED ENVIRONMENTAL RESEARCH AND DEVELOPMENT

Although substantial environmental research and development has been carried out in the United States since the late 1960's, the need for effective research is greater today than ever before, for two reasons. First, we have come to learn that significant health and environmental effects can result from many of the persistent toxic

substances which are associated with the advanced technology used in our industry, agriculture and transportation systems. Second, we cannot mitigate or control all possible environmental risks in the foreseeable future. Thus we must rely on an aggressive research and development program to prioritize and resolve the most challenging risks to our society. I do not believe our current national research program is adequate for this task.

The Council on Environmental Quality has estimated that the direct costs of environmental controls are approximately one percent of the GNP in the United States, or approximately \$30 billion per year. This large public expenditure should be supported by an R&D program adequate to set priorities for risk reduction and to prescribe efficient control methods where needed. However, EPA's extramural research budget has been running at the rate of a fraction of one percent of the national direct costs for environmental control in recent years. Significant reductions in the R&D budget increase the potential for unneeded, inefficient and excessively costly environmental control programs.

RECOMMENDED GOALS FOR ENVIRONMENTAL R&D

I believe that federally supported environmental R&D should have five principal goals. It should:

1. Explore for possible risks to public health and the environment -- this exploratory research was one of the earliest activities of the federal program, dating back to the early 1970's. Such exploratory research on effects is even more needed now, as our concern for a range of known or suspected toxic substances has grown.
2. Analyze cause-and-effect relationships -- for example, our ability to prescribe cost effective reductions in acid deposition is severely limited because of our lack of technical understanding of the key factors and reaction rates which influence the source-transport-transformation-deposition chain for air contaminants from stationary and mobile sources.

3. Monitor trends of contamination in the environment -- it is almost always better to evaluate long term trends with a few, high quality measurement sites than to operate large measurement networks temporarily.
4. Prioritize among environmental risks -- as measurement technology has improved, an even greater number of risks to health and the environment have been identified. Priority ranking of the degree of risk associated with various pollutants must be a goal of the nation's environmental research program.
5. Develop effective and cost efficient control methods -- public sector funding of seed money to explore innovative control methods must be continued, especially for the management of toxic substances in (air and water) waste streams.

NEED FOR IMPROVED COLLABORATION
BETWEEN FEDERAL AND NON-FEDERAL
SPONSORED RESEARCH AND DEVELOPMENT

Environmental research needs in the United States are so large, and the constraints on the federal budget are so severe, that optimum coordination and efficiency must be sought between federal and non-federal sponsored activities. Examples from three high priority research areas will illustrate this need:

Acid Precipitation Research - Although the federal budget commitment to acid precipitation research is relatively large (over \$25 million in FY 1983), other major multi-element programs are underway and are being expanded by the Electric Power Research Institute and by provincial and national government units in Canada, among others. Acid precipitation does not respect political or sectorial (e.g., public vs. private sponsorship) boundaries, and the underlying measurements, theories and scientific analyses are independent of these administrative distinctions. EPA should seek the most complete

collaboration possible with these other programs, and should encourage other sponsors to develop complementary aspects of the needed research. EPA leadership in formal collaboration would greatly enhance the effectiveness of the entire research effort.

Toxic Substance Studies - In all modern industrialized nations, a very large group of potentially hazardous substances are found in the ambient environment. Research needs for effects assessment, description of the fate of these substances in the environment, and evaluation of control options are much greater than the research capacity of the federal government alone. Formal collaboration between EPA, industry sponsored studies and university research is needed to "share the burden" of needed research.

Ambient Monitoring - Ambient monitoring is carried out throughout the nation by a very large group of sponsors, including EPA, state environmental agencies, regional government units, regulated industries, and universities. Although many attempts at national record-keeping, methods standardization, and quality assurance programs have been initiated, only a small percentage of all ambient measurement data is ever organized into useful regional and national scale data bases. Measurements of priority pollutants (toxic substances) in surface waters are particularly limited in all parts of the nation. Monitoring is intrinsically expensive, and EPA should do all possible to maximize the utility of the available measurement programs. This is an old issue, but our national performance in gathering useful monitoring data has not significantly improved in many years.

Guidelines for Effective Non-federal Collaboration - Each of the examples just discussed illustrates the guidelines for effective collaboration between EPA and non-federal sponsors of environmental research. The guidelines which I recommend are:

- 1) EPA should actively adopt the responsibility to lead and coordinate national environmental research efforts.

- 2) Formal recognition of complementary research programs should be accomplished through adequate communication and written reports reflecting joint program planning.
- 3) All research sponsors should be encouraged to collaborate whenever possible.
- 4) Research programs should be conducted by "good science" standards, not by adversarial methods.

HIGH PRIORITY RESEARCH AND DEVELOPMENT NEEDS

I wish to recommend five key R&D areas for special consideration by the Committee. These include the three areas cited in my previous examples, and two others: (1) acid rain, (2) toxic substances, (3) ambient trend monitoring, (4) personal exposure and dosage studies (indoor air quality and food chain exposures), and (5) new control technology developments.

Acid Precipitation

The Acid Precipitation Act of 1980 (Title VII of P.L. 96-294) established the National Acid Precipitation Assessment Program (NAPAP) and its oversight task force on which I serve. NAPAP has been funded at the level of approximately \$18 million in FY 1982, \$25 million in FY 1983, and a further increase in budget for FY 1984 is projected. In my view the interagency research program has been modestly successful to date, given the constraints of operating by "consensus and coordination", instead of by direct program control. However, the need for rapid, effective research on many aspects of the acid precipitation phenomenon is very great; improved efficiency would result from a more unified program. I recommend the Subcommittee give careful consideration to the following steps:

- 1) Create a single research project on acid precipitation, with all necessary facilities and staff seconded to the program as needed.

- 2) Require EPA (or CEQ) to closely coordinate the federal research effort with all appropriate non-federal research programs.
- 3) Require periodic reporting of research results to the Congress, for its use in evaluating acid precipitation control needs.

Toxic Substances

Improvements in analytical techniques have greatly increased the range of observation of toxic substances in the environment in recent years. Much research is needed to determine the possible health and environmental effects of various toxic substances to assess their occurrence in the environment, and to prioritize the need for their control.

Monitoring of Ambient Trends

Ambient trend monitoring provides the best "scorecard" about our national progress in environmental management. Long-term continuation of appropriate monitoring programs should be given high priority, and adequate support for quality assurance in monitoring networks should be provided.

Personal Exposure Studies (Indoor Air Pollution and Food Chain Studies)

Most human health effects related to pollutant exposure result from air exposures inside residential, commercial and industrial structures, and from ingestion of food or water partly contaminated with pollutants. Increased research emphasis on actual personal exposures, health risks and mitigation measures should be considered by the Subcommittee.

New Control Technology Development

In recent years Congress has decreased its authorizations for pollution control technology development, because the private sector has developed commercial technologies in many cases. However, new control needs continue to be identified, for example, for trace amounts of toxic substances in air emission and wastewater streams. Moreover, more research on "system controls" is needed in some important cases. For example, least-emissions dispatching from electric power networks may be a low cost alternative to widespread application of flue gas desulfurization technology. Congress should continue to provide development support for those control options which would not normally be developed by private sector initiative.

I trust that these comments will be useful for your consideration of federal environmental research and development needs. I appreciate the opportunity to share these views with you.



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Testimony of

Daniel J. Goodwin

Illinois Environmental Protection Agency

Division of Air Pollution Control

on behalf of the

State and Territorial Air Pollution

Program Administrators

(STAPPA)

Concerning

Environmental Research and Development

before the

Senate Environment and Public Works Subcommittee

on Toxic Substances and Environmental Oversight

June 14, 1983

Good morning. My name is Daniel J. Goodwin. I am manager of the Division of Air Pollution Control of the Illinois Environmental Protection Agency. I am appearing here today as spokesman for STAPPA, the State and Territorial Air Pollution Program Administrators, the national organization of professionals who direct the nation's air quality programs at the state level.

On behalf of STAPPA, I want to thank the Committee for this opportunity to present some of our views on the nation's environmental research and development program.

There is probably no area of government activity pertaining to environmental protection where state officials must depend more heavily on federal assistance than the area of research. Improved knowledge of pollutant sources, transport, fate, monitoring techniques, effects on vegetation and materials, and -- especially -- effects on human health, are crucial to the success of state programs for air pollution control. Yet, no state could possibly provide itself with adequate research support using only its own resources. Not only would the cost be prohibitive, but the network of academic and scientific communication institutions which forms the infrastructure of a productive research program demands a national-scale effort. Consequently, I would urge the Congress to regard a vigorous federal environmental research and development program as an essential component of the evolving federal-state partnership for managing environmental quality.

Furthermore, it should be recognized that adequate, stable funding for environmental research is also essential. If funding is not adequate over the long term, we will deprive ourselves of early understanding of tomorrow's problems and the tools to prevent or solve them. If funding is not stable year-to-year, critical gaps in our knowledge pertaining to today's problems may go unfilled, and wasteful inefficiencies in research program management are inevitable. I recommend that these two factors, long term funding adequacy and short term funding stability, be weighed carefully in the budgetary processes of Congress.

Careful thought must also be given to the respective roles of the federal government and the private sector in the conduct of needed environmental research. Unlike computer science, pharmaceuticals, genetics, electronics, materials science, and many other fields of research and development, the potential for profit is largely ineffective as a driving force for privately-funded environmental research. Most of what does occur is defensive in orientation, i.e., it is done for the purpose of disproving the existence of an environmental problem or the propriety of a contemplated regulatory requirement. While this defensive research often produces valid, useful information for government decisionmakers, we must rely on the public sector to seek out the subtle adverse effects on health and environment which result from man's activities, and to develop the understanding of the physical, chemical, and biological processes that lead to those adverse effects so that they may be avoided or remedied.

Even where the need for corrective measures has been identified, it would be unwise to rely on the private sector to provide solutions. The argument that the free enterprise system will assure development of improved pollution control technology by providing rewards to companies which develop more cost-effective control techniques is weak at best. Several overriding factors interfere with this mechanism for innovation.

First, it should be recognized that most companies that have strong research and development capabilities are simply not interested in whatever market may exist for pollution control technology. They have plenty of projects pertaining to the markets they do find of interest to utilize fully their available research and development resources.

Second, our national environmental regulatory scheme rarely provides incentives for innovation, but it often provides disincentives. I will illustrate with two examples. A particular new control technology may be identified which, if developed, would allow removal of 90 percent of the pollutants controlled by the standard technology currently in use, but at only 50 percent of the cost. However, because emission standards have been established on the basis of the effectiveness of the current technology, the opportunity to use the much cheaper, but slightly less effective technology does not exist.

Another example focuses on the risk inherent in a full-scale demonstration of a new technology. The Clean Air Act allows waivers of compliance with new source performance standards for a maximum period of seven years where it is found that innovative technology will be used which has a reasonable chance of ultimately meeting the standard after full-scale operating experience has been obtained. But the big risk that goes with this waiver is that if the innovative technology ultimately fails even by a small margin to meet the standard, it must be abandoned and some other technology used.

These examples have not been offered as criticism of our regulatory scheme, necessarily, but rather to illustrate the point that continued federal funding of control technology research, development, and demonstration is essential if we expect continued rapid innovation in this area.

Let us now turn to some specific subject areas where additional federally sponsored research is needed.

The members of this Committee are well aware of the slow pace at which the U.S. Environmental Protection Agency has moved in regulating emissions to the atmosphere of substances known or suspected to be hazardous to human health. Yet, the public is quite properly demanding that protection against toxic air emissions be provided even where many uncertainties exist concerning health effects and needed level of control. Because rapid improvement in this aspect of the federal regulatory program does not appear imminent, a growing number of state and local air pollution control agencies have initiated efforts to control toxic air emissions. Most of these programs are seen as providing an interim measure of control on the most important sources of hazardous pollutants until the full degree of control contemplated by federal law can be defined and implemented.

Assessment of the health effects of the much-discussed list of 37 substances should be a matter of highest priority in the federal environmental research program. In addition, information on the sources, transport, fate, and control methods for these substances is needed not only by air quality regulators, but by our counterparts in water quality and waste management as well. State and local environmental officials must make timely permit and standards decisions for sources of these substances virtually every working day, and the absence of complete information does not excuse us from those decisions. Consequently, those sources which do in fact pose significant health risks may escape adequate control by virtue of our ignorance. Accelerated research, and equally important, improved information dissemination to state and local regulators, are crucial to prevention of blind decisionmaking for these sources of pollution.

Another high priority research area is acid deposition. This Committee does not need to be told of the importance of this subject or of the major uncertainties surrounding the causes, effects, and potential benefits of various control measures that have been proposed. The increased emphasis on acid deposition research

contained in the Administration's FY 1984 budget is commendable and should be endorsed by Congress irrespective of the outcome of the debate on whether immediate control measures are warranted. Clearly, we need a vastly improved understanding of the acid deposition phenomenon.

A third area where a vigorous federal research program is important is that of energy development. Synthetic fuel production processes still loom as eventual, if not imminent, components of our national energy supply system. Characterization of the emissions and other environmental effects of these processes should continue as a federal research priority, along with necessary mitigative techniques.

Techniques for reducing sulfur dioxide and nitrogen oxide emissions from combustion of coal and other fossil fuels are important both for energy independence and as possible acid deposition controls. Demonstration of improved SO_2 and NO_x control technology suitable for retrofit use, such as the limestone injection multi-stage burner (LIMB) technology, is especially important.

Finally, I will conclude by suggesting that the federal environmental research and development program could be improved in terms of the utility and timeliness of its results if more systematic mechanisms were employed for surveying the program's customers, i.e., the staffs of the federal, state, and local regulatory agencies who apply the knowledge generated on a daily basis. If more systematic mechanisms for identifying critical knowledge gaps and emerging problem areas were used, the body of information generated would likely be more useful and timely for the regulators.

Again, thank you for the opportunity to testify. I will be glad to answer any questions you may have.

EPRI

ENVIRONMENTAL CONTROL R&D
BY THE
ELECTRIC UTILITY INDUSTRY
AT
ELECTRIC POWER RESEARCH INSTITUTE

STATEMENT OF
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FOR THE
SUBCOMMITTEE ON TOXIC SUBSTANCES AND ENVIRONMENTAL OVERSIGHT
SENATE COMMITTEE ON ENVIRONMENT AND PUBLIC WORKS

JUNE 14, 1982

ELECTRIC POWER RESEARCH INSTITUTE

ENVIRONMENTAL CONTROL R&D BY THE ELECTRIC UTILITY INDUSTRY
AT ELECTRIC POWER RESEARCH INSTITUTE

Introduction

EPRI Environmental R&D Program

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References

- Appendix 1 - Environmental Assessment Department 1983-1987
R&D Program Plan
- Appendix 2 - Environmental Control Systems Department
1983-1987 R&D Program Plan
- Appendix 3 - Technology Applications
- Appendix 4 - Coal Combustion Catalog

Biographical Information

ENVIRONMENTAL CONTROL R&D BY THE ELECTRIC UTILITY INDUSTRY
AT ELECTRIC POWER RESEARCH INSTITUTE

INTRODUCTION

I am George T. Preston, Director of the Environmental Control Systems Department of the Electric Power Research Institute (EPRI). I appreciate the invitation to provide information on EPRI's research program in environmental control technology for the electric power industry.

EPRI was established by the electric utility industry in 1973 to plan and manage a comprehensive research, development and demonstration program for the electric utility industry and its ratepayers. EPRI is supported by voluntary contributions from investor-owned, government and cooperatively owned utilities across the nation. Our present 1983 budget calls for research expenditures of \$269 million.

Near-Term vs. Long-Term Research Goals

In the late 1970s, the time horizon of EPRI's research program gradually shifted toward a near-term emphasis. This was at a time when there were substantial Federal research programs in energy and environment, with an emphasis on longer-term goals that complemented EPRI's near-term goals. However, events of the first three years of this decade have complicated the challenge of establishing the appropriate balance between near-term and longer-term research goals for EPRI. Three of the major complicating factors are:

- o Lowered electricity demand projections and high interest rates have imposed severe financial limitations on the electric utility industry, and this has been reflected in significant cutbacks in EPRI's R&D funding. For example, EPRI's planned research expenditures for 1984 and 1985 are now lower than we projected two years ago, by 15% and 20%, respectively.
- o Substantial cutbacks in Federal research leave serious gaps in several important long-term programs affecting the utility industry.
- o The industry's need to keep existing plants operating reliably (often far beyond their design lives), exerts increasing pressure on EPRI to keep a high priority on near-term research goals.

Currently, the result of our balancing of these factors is that the share of EPRI's research expenditures directed to long-term goals is beginning to grow again, even in the face of the industry's critical near-term needs. Still, even just a year ago, almost 70% of the Institute's annual research budget was directed toward research goals that were to be achieved within a 10-year period (1).

The near-term emphasis of environmental control R&D at EPRI is more pronounced than that of EPRI as a whole; for example, over 85% of my Environmental Control Systems Department's budget for 1984-1988 will be directed at projects whose results will be available for implementation within five years after we begin the research.

Scope of Testimony

With the above background in mind, I have focused on three questions in this testimony:

- o What is the nature and scope of EPRI's environmental research program, particularly in environmental control technologies?
- o How important is Federal involvement in environmental R&D
- o What joint Federal/EPRI environmental R&D efforts have been carried out, and what programs should be considered in the near future?

EPRI ENVIRONMENTAL R&D PROGRAM

Environmental Research

The major environmental programs at EPRI are carried out in the Environmental Assessment Department and the Environmental Control Systems Department. The scope of research in these two departments is summarized as follows:

Environmental Assessment Department - Data acquisition and evaluation, correlational and predictive modeling in the areas of atmospheric chemistry, meteorological phenomena, ecological effects, and human health effects associated with air, water-borne, and solid power plant effluents, transmission lines, and cooling systems. Annual research expenditures about \$30 M.

Environmental Control Systems Department - Evaluation, development, and demonstration of technologies and systems for particulate, SO₂, and NO_x emissions control; water discharge monitoring and treatment; heat rejection; solid wastes management and utilization; and integration of environmental control systems into the design and operation of the power plant. Focus on coal-fired power plants. Annual research expenditures about \$20 M.

The research programs in the Environmental Assessment Department and the Environmental Control Systems Department are described in Appendices 1 and 2, respectively, which are excerpted from the EPRI 1983-1987 R&D plan (2).

The charts on the next page show planned EPRI funding for environmental R&D in 1983-1987. The programs in the two environmental departments represent about 16% of the Institute's funding. The "other environment-related" category includes research that has implicit environmental benefits, such as coal cleaning, fluid bed combustion, coal gasification, coal liquefaction, and solar energy. (One could also include our programs in conservation, load management, batteries, etc., but I have not done so.) Including "other," EPRI's environment-related research represents 37% of the R&D funding for the Institute as a whole.

An indication of the near-term emphasis of EPRI's environmental R&D is the extent to which utility companies have already implemented many of the research results. Appendix 3 includes descriptions of examples of utilities' application of technology advances from our programs. In all these examples, the cited operating and financial benefits have been estimated by the individual utility rather than by EPRI staff.

Environmental Control Research

From this point, the scope of this testimony narrows to focus on EPRI's research in environmental control technologies, i.e. the R&D program of the Environmental Control Systems Department.

Brief descriptions of Environmental Control Systems Department projects are given in the Coal Combustion Catalog (Appendix 4, provided separately). The Catalog is a reference document wherein project descriptions can be found indexed by technical subject.

FEDERAL AND EPRI ROLES IN ENVIRONMENTAL R&D

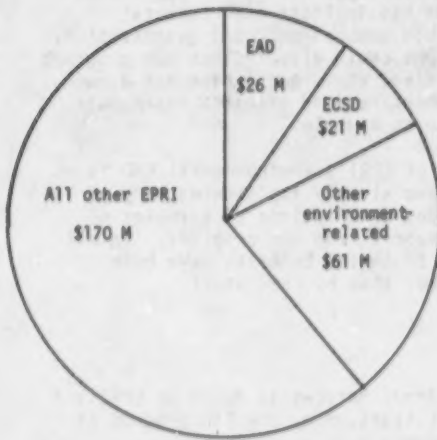
Two important criteria that can be applied by a research organization in judging the relative emphasis to put on competing research programs and the appropriate role for the organization to take, are:

- o To what degree will the product of the research address the needs of the organization's constituents?
- o Does the organization contribute something to the research that other organizations cannot?

We try to apply these criteria carefully at EPRI, and I feel they are equally appropriate for Federal research programs.

Federal Criteria

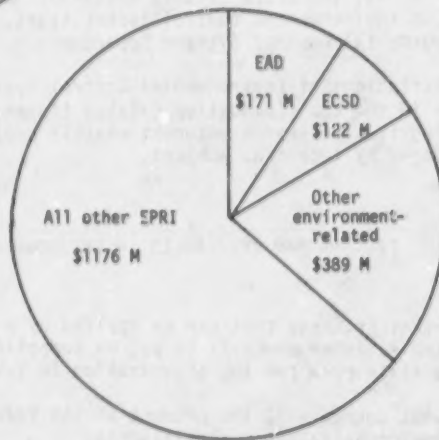
The needs of the Federal Government's constituents can certainly be addressed by a broad scope of environmental research areas; however, many of these can be appropriately pursued by the private sector. Categories of environmental control research where Federal involvement can contribute in ways that other sectors cannot, include:

EPRI ENVIRONMENTAL RESEARCH FUNDING

EAD - Environmental Assessment Dept.

ECSD - Environmental Control Systems Dept.

1983
EPRI total \$278 M



1983-1987
EPRI total \$1858 M

Source: 1983-1987 R&D Program Plan, January 1983.

- o Long-range exploratory research to identify new principles, processes and concepts and to obtain the fundamental data required to assess their potential to address environmental issues. By sponsoring research in this category, the Federal government could be expected to provide national scientific leadership which can stimulate related private sector programs and can contribute to the relevance of fundamental research programs at universities and the national laboratories.
- o Large demonstration programs whose cost and risks must be shared among several participants. Federal financial and technical participation in the past has been essential to the success of several such programs, some of which are cited in a later section of this testimony.
- o Research required to support Federal regulatory development. In the ideal, research in this category should account for a relatively small (or zero) fraction of the Federal research program, for two reasons:
 - There is an inherent conflict in Federal sponsorship of research whose purpose is to define requirements or demonstrate compliance capabilities for a proposed Federal regulation.
 - Excessive direction of Federal research funding to this category leads to research programs that have no long-lasting benefit to the nation; the benefits are all short-term, and the accomplishments tend to be legislative rather than scientific.

These issues were identified in an Office of Technology Assessment review in 1976 (3); the Federal government does not appear to have addressed them successfully in the meantime. Long-range anticipatory research that is well planned, consistently funded and competently managed, and is strongly coordinated with the university and private sectors, could provide objective data in advance of regulatory issues, in order to minimize the need for research that responds narrowly to a specific regulatory area.

EPRI Criteria

The two general criteria cited earlier are stated more specifically in EPRI's Overview & Strategy (1):

- o Will the research and development have a significant effect in the next several decades on reducing electricity costs, maintaining an acceptable environment, and ensuring the availability of economic energy resources?
- o Will the Institute fill an essential role in the performance of the research? Will the EPRI research be a substantive addition to the activities underway at other organizations?

Federal programs typically have emphasized longer-term research goals. On the other hand, environmental control equipment suppliers, another important R&D sector, tend to concentrate on proprietary development of specific new equipment. The EPRI program tries to fill the gap by stimulating generic improvements in established technologies and accelerating their implementation, and by identifying and encouraging commercialization of new environmental control technologies that offer significant cost savings and reliability improvements for the benefit of the electricity ratepayers and the utility industry.

EPRI Role

Defining the specific role that EPRI should assume in supporting research is a key aspect of management. For example, EPRI functions in the following capacities:

- o Principal Sponsor - A leadership position in which EPRI has the major role in initiating and supporting the research and development.
- o Major Participant - A position as major participant and cosponsor with manufacturers, private research organizations, EPA, DOE, or other government agencies. This role often includes arranging a utility host site for a major technology demonstration.
- o Selective Participant - A position that selectively supports research, development, and assessment projects aimed at ensuring that the utility systems needs are recognized and integrated into the development of new technologies.

The Principal Sponsor and Major Participant categories are used to characterize research projects described below in the section titled "Joint Federal/EPRI Environmental Control Research Programs."

Joint Federal/EPRI Research

Jointly sponsored environmental control technology development and demonstration programs have the greatest potential for significant benefit from Federal environmental R&D. In many cases, even when funding is not a limitation, the technical success and the degree of implementation of research results is substantially greater from a joint EPRI/Federal research project than could have been expected if either organization had undertaken the project alone. This is true despite a number of well-recognized disincentives for undertaking such joint programs, as follows:

- o Extraordinarily meticulous planning and coordination are required to ensure that all parties' technical and programmatic objectives can be satisfied. Sometimes this cannot be achieved, and a potential joint effort is not undertaken. Example: EPRI and EPA contemplated an evaluation of a continuous emissions monitoring system in 1981 but were unable to structure a joint program that could meet both our objectives.

- o The carrying out of complex joint projects is often inefficient from the standpoint of achieving agreed-on technical goals on schedule, because the normal R&D budget and scheduling uncertainties are compounded when two or more organizations are involved. Example: EPRI initiated a major program in SO₂ scrubber chemistry. At DOE's suggestion in 1980, we made it a joint, expanded program. Following deletion of the DOE portion of the program in 1982, we have picked up the more critical elements once again - but they are now two years behind our original schedule.
- o Patent, liability, and/or procurement policies are often significantly different, and protracted negotiations may be required to accommodate these differences.

The importance of joint EPRI/Federal environmental control research stems from the following advantages of joint programs, relative to research done by a single organization:

- o The credibility of the research results is enhanced.
- o In many instances, a research program that is only incrementally expanded beyond either organization's own technical objectives can achieve the goals of both organizations at a fraction of the cost of carrying out separate programs.
- o First-of-a-kind demonstration of important environmental control technologies can be achieved by the sharing of technical and financial risks among two or more organizations, whereas either alone might not have the financial or technical resources to manage the effort itself.

JOINT FEDERAL/EPRI ENVIRONMENTAL CONTROL RESEARCH PROGRAMS

Joint Programs to Date

Past and current joint EPRI/Federal environmental control research programs are summarized in Table 1. As mentioned earlier, the focus of these efforts is on environmental control for fossil-fired power plants. This summary serves to illustrate that:

- o There has been significant Federal funding in a broad cross-section of EPRI's environmental control technology research.
- o Both Federal and EPRI funding have been significant in the joint programs.

Table 1. Joint EPRI/Federal Environmental Control Research

Technology	Years	Federal Agency	Federal \$M	EPRI \$M	EPRI Role (1)	Objective/Results
Combustion control	74-75	EPA	0.3	0.2	NP	Field evaluation of combustion modifications to reduce NOx and other emissions
Combustion control	74-75	EPA	0.1	0.2	NP	Combustion and emission characteristics of low Btu gas
Precipitators	75-76	EPA	0.3	0.5	NP	Define rapping and reentrainment mechanisms, effect of gas conditioning on ash resistivity
Precipitators	76-83	EPA	0.1 ⁽²⁾	2.1	PS	Define mechanisms of flue gas conditioning for ESP per performance improvement
Precipitators	79-81	TVA	1.2	0.5	NP	Full-scale high intensity ionizer evaluation
Precipitators	80-83	EPA	0.1	0.3	PS	Pulsed power supply tests
Particulate control	84+	EPA	0.1	0.1	NP	Joint particulates control symposia
SO ₂ scrubbers	75-78	ERDA, EPA, TVA	4.4	0.6	NP	Pilot scale scrubber process developments
SO ₂ scrubbers	77-85	DOE	1.0 ⁽²⁾	3.9	PS	Scrubber chemistry development and model
SO ₂ scrubbers	77-80	TVA	1.4	4.4	NP	Prototype scrubber evaluations
SO ₂ scrubbers	78-84	EPA	0.5	0.4	NP	Design guidelines, scrubber data base
SO ₂ scrubbers	78-85	EPA	9.3	\$3.1 ⁽³⁾	NP	Sulfur recovery SO ₂ scrubbing demonstration (Aqueous Carbonate Process)
SO ₂ scrubbers	80-84	EPA	0.3	3.4	NP	Spray-dry SO ₂ scrubber evaluation
SO ₂ scrubbers	82,83+	EPA	0.1	0.1	NP	Joint SO ₂ control symposia
NOx removal	76-78	TVA	0.1	0.4	PS	Evaluation of postcombustion NOx removal
NOx control	78-82+	EPA	0.2	0.2	NP	Joint NOx control symposia
Cooling water intake	78-82	EPA	0.5	0.8 ⁽³⁾	NP	Porous dike intake structure demonstration
Cooling system	78-80	EPA, ERDA	0.8	0.2	NP	Cooling system design to minimize entrainment mortality
Cooling towers	78-79	EPA	0.4	0.2	NP	Cooling tower blowdown evaporator/crystallizer tests
Cooling towers	81-85	TVA	0.2	2.6 ⁽³⁾	PS	Cooling tower performance pilot tests
Wet/dry cooling	75-79	ERDA, EPA	0.2	0.1	NP	Wet/dry cooling performance test and model
Dry cooling tower	76-85	DOE, EPA	3.0 ⁽²⁾	15.6 ⁽³⁾	PS	Ammonia dry cooling demonstration
Ash and sludge disposal	78-83	DOE, EPA	1.5	1.3 ⁽³⁾	NP	Ash-and-sludge artificial reef demonstration
Ash utilization	78-83	DOE, ORNL	0.2	0.4	NP	Acid leach alumina recovery development
	74-85		25.6	91.6 ⁽³⁾		

(1) PS = Principal Sponsor, NP = Major Participant

(2) Federal agency planned stronger rule, but budgets were cut

(3) Includes utility and other private sector contributions: total EPRI funding \$46.3 M out of \$91.6 M.

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Future Efforts

Potentially fruitful research areas for future joint efforts include the following:

- Full-scale demonstration of SO₂ control by injection of dry sorbent (limestone) into a utility boiler
- Low NO_x combustor development and full-scale demonstration
- Electrostatic precipitation pilot testing and development at existing (unused) EPA facilities at Public Service of Colorado Valmont station and TVA Bull Run station
- Aqueous discharge sampling and analysis protocol development
- Resource recovery/utilization of large-volume combustion by-products, e.g. fly ash
- Low-volume wastes fixation technology demonstration

CONCLUSION

Several conclusions should be drawn from the testimony I have presented here.

- o A strong Federal environmental research effort is essential to the nation. The Federal role is particularly important in long-range exploratory and anticipatory research, and in large shared-risk demonstration programs.
- o Joint EPRI/Federal environmental research programs are a cost-effective means for achieving similar objectives. Many of these joint programs have already produced valuable results. Further opportunities for such programs should be pursued.
- o In building on the strengths of two or more organizations, joint environmental research programs can accomplish technical objectives that the organizations operating individually could not achieve. Potential programs that offer this advantage should be given high priority in the Federal research planning process.

REFERENCES

1. 1982-1986 Overview & Strategy, EPRI P-2156-SR, Electric Power Research Institute, Palo Alto, February 1982.
2. 1983-1987 R&D Program Plan, EPRI P-2799-SR, Electric Power Research Institute, Palo Alto, January 1983.
3. "A Review of the U.S. Environmental Protection Agency Environmental Research Outlook, FY1976-1980," U.S. Congress Office of Technology Assessment, August 1976.